RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

Owned and Published by
THE RADIOLOGICAL SOCIETY
OF NORTH AMERICA
As its Official Journal

JANUARY, 1927

Vol. VIII

Number 1

PHYSIOTHERAPY

ENGELN

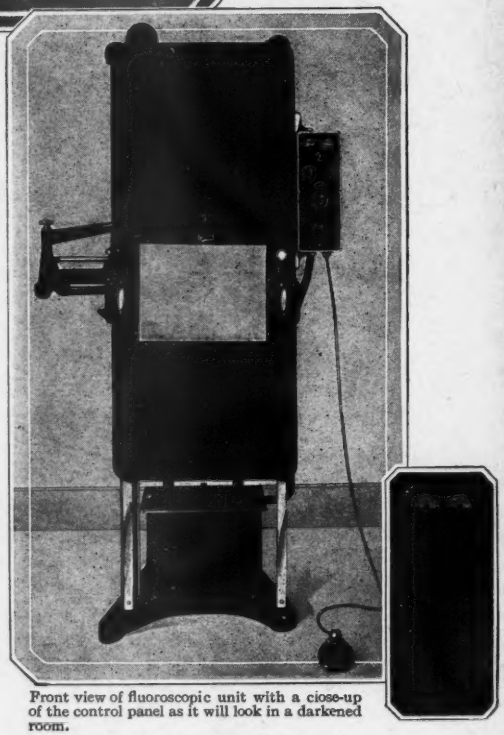
X-RAY

A New X-Ray Unit Adapted to Diagnostic Work in YOUR Office

YOU will be interested in looking over our descriptive booklet which, in an interesting, readable style, explains the many important and valuable features of this new Engeln Equipment.

Exceptional Quality at a Very Low Price
Unusual Power and Capacity
Simplified Controls
Absolute Safety
Minimum Space Required in Your Present Office
At Your Price and Terms

Your request will bring this new booklet by return mail.



Front view of fluoroscopic unit with a close-up of the control panel as it will look in a darkened room.

THE ENGELN ELECTRIC COMPANY

X-Ray and Physiotherapy Equipment

SUPERIOR AVENUE AT EAST THIRTIETH STREET, CLEVELAND, OHIO

Please send me complete information on the new Fluoroscopic Unit

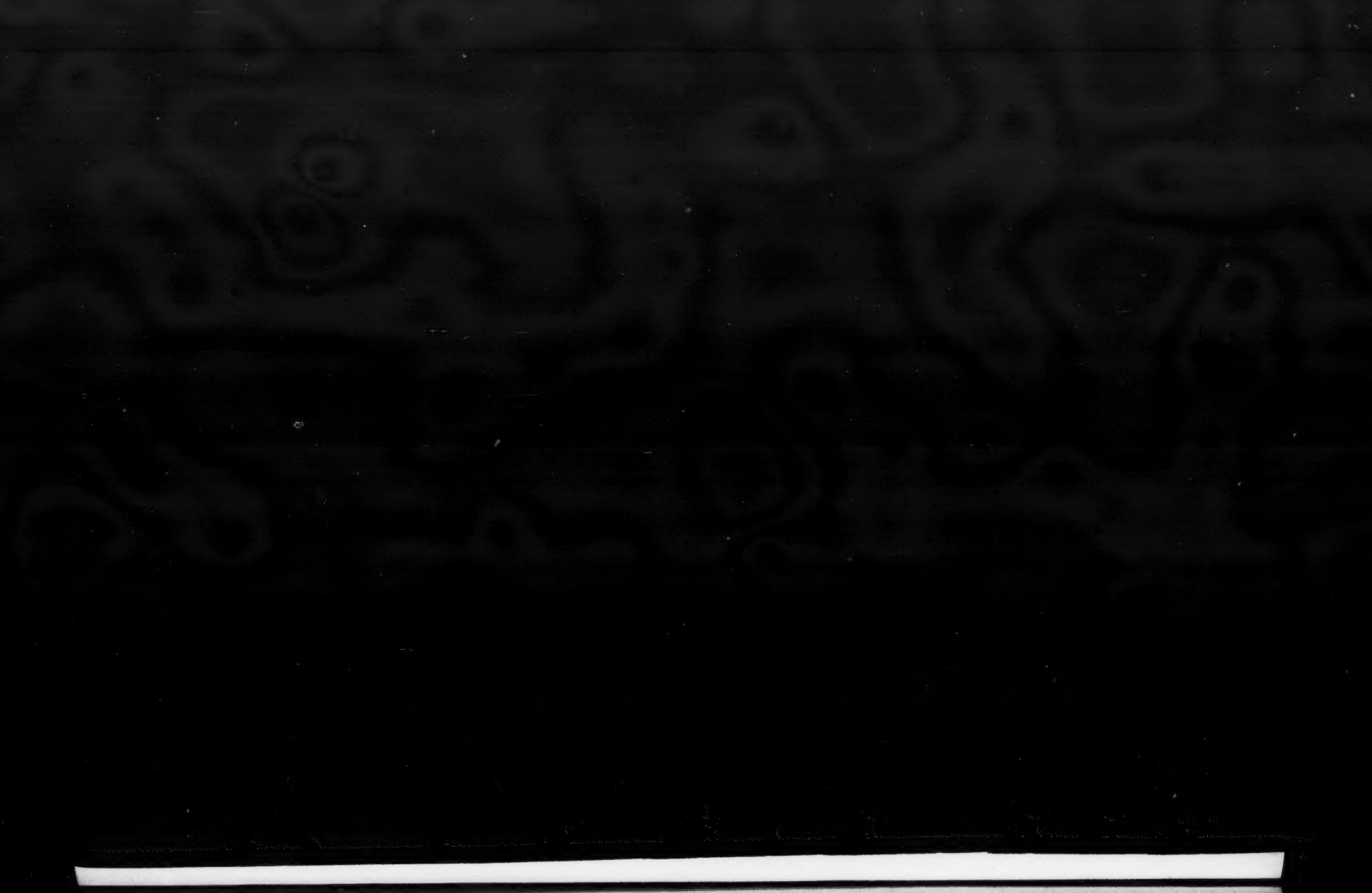
DOCTOR .....

OFFICE .....

CITY ..... STATE .....

F-10

Branch Offices and Service Stations in All Principal Cities.



RADIOLOGY

A MONTHLY JOURNAL DEVOTED TO CLINICAL RADIOLOGY AND ALLIED SCIENCES

PUBLISHED BY THE RADIOLOGICAL SOCIETY OF NORTH AMERICA

VOL. VIII JANUARY, 1927 No. 1

MASSIVE COLLAPSE OF THE LUNG[1]

WITH REPORT OF THREE UNUSUAL CASES

By L. R. SANTE, M.D., F.A.C.P., F.A.C.R., ST. LOUIS, MISSOURI

MASSIVE collapse of the lung is a condition in which one or more lobes, previously well aërated, lose their air content and collapse. It has been well defined by John Rose Bradford (*7*) as "an unusual condition in which the lung, without the presence of any gross lesion, such as bronchial obstruction, pleural effusion, etc., interfering with the free entry of air, becomes airless to a greater or less degree."

In its collapsed state the lung occupies a smaller space than it did when fully expanded, and becomes denser in character. The condition is not associated with pneumothorax, nor is there any separation of the lung from the chest wall. To compensate for the space lost from collapse of the lung, the chest wall is depressed, the heart and mediastinal structures are drawn over toward the involved side, and the diaphragm is pulled upward. When one considers the small size to which a normal lung may collapse in the presence of pneumothorax and its relative radiolucency when fully collapsed, it is surprising that in this condition a fully collapsed lung could occupy so much space and acquire the marked density that it does. The radiographic density of the lung in massive collapse is fully as great as that seen in lobar pneumonia. It is homogeneous in character and has the same distribution as in lobar pneumonia, rendering its differentiation from this condition at times somewhat difficult.

The physical signs likewise are similar to pneumonia. The reduction in width of the chest cavity on the involved side, the narrowing of the interspaces, the elevated position and immobilization of the diaphragm, and especially the retraction of the heart and mediastinal structures toward the involved side, serve to establish the diagnosis. If the lower lobe or entire lung is involved, the heart will be markedly displaced, the apex beat being a guide to the clinician of the amount of displacement. This seems to be one of the most constant signs. Where the upper lobe alone is involved, displacement of the heart may be negligible and deviation of the trachea may be the only sign. There may be a compensating emphysema of the uninvolved side.

The condition is most frequently encountered as a complication after abdominal or rectal operations, especially appendectomy and herniotomy. Its incidence is apparently independent of the anesthetic, cases being reported with all types of anesthetic, even spinal anesthesia. It occurs after fractures of the pelvis or of femurs, and after injuries, apparently trivial, to the abdomen, chest or buttocks. The condition may result from

[1]From the Radiology Departments of St. Mary's Hospital and St. Louis City Hospitals. Paper read before the Radiological Society of North America, at Milwaukee, Wisconsin, Nov.-Dec., 1926.

post-diphtheritic paralysis of diaphragm or after poliomyelitis.

This condition is by no means a recent observation, and is well established as a clinical entity. In 1890, W. Pasteur (1) was the first to definitely describe this condition and he gave it the name, "massive collapse of the lung." His first observations were on thirty-four cases of massive collapse which followed post-diphtheritic paralysis of the diaphragm.

In the Bradshaw Lecture, in 1908 (2), he discussed the nature of massive lobar collapse of the lungs as contrasted with the scattered lobular collapse that may occur when the bronchioles are obstructed by secretions and the alveoli slowly emptied by absorption of their air into the circulating blood. He considered the cause of the collapse to be due to paralysis of the diaphragm and other respiratory muscles, and suggested that reflex inhibition of the diaphragm might lead to similar results.

In 1914 he (3) again called attention to the condition as a post-operative complication of abdominal cases. He reported sixteen cases in two thousand abdominal operations, and stated that he had seen a similar condition after injury to the chest wall. The pathology was the same.

In the same year, Elliott and Dingley (4) reported eleven cases which also followed abdominal operations. These authors analyzed the situation thoroughly and came to the conclusion that immobilization of the diaphragm and shallow respiratory movements allowed the bronchioles to become blocked with secretions, the circulating blood absorbing the residual alveolar air.

Holmes (5) cites four cases and refers to twelve cases found by Bradshaw among 3,559 patients operated upon at the Middlesex Hospital from 1906 to 1910. These cases all occurred after abdominal operations, especially appendectomy and herniotomy.

Crymble (6) reported fifteen cases after gunshot wounds.

In 1918–1920, Sir John Rose Bradford (7) made a complete study of the subject in connection with war wounds. He failed to find any postmortem evidence of bronchial obstruction, pleural effusion or other lesion, which might interfere with aëration of the lung, and concluded that, while it seemed incredible, the evidence would seem to indicate that a reflex spasm of the bronchioles was the cause of the obstruction. The condition was observed after injuries to the chest and trunk, after fracture of the pelvis or femur, and after gunshot wounds of the chest. Bradford cites a case where apparently a trivial wound of the chest was followed by collapse of the opposite lung, where no anesthetic was used and where no operative interference had been undertaken. Some injury, however, seemed to be present in all cases.

Briscoe (8), in 1920, analyzed the possible causes of massive collapse and concluded that it was produced "by the onset of inflammation affecting the muscles of the crus situated behind the peritoneum; one-half of the diaphragm and its synergistic and antagonistic muscles are out of action owing to inflammation of the muscle or the pleural membrane covering it."

In 1921, Scrimger (9) reported seven post-operative cases among 540 abdominal and rectal operations; six followed herniotomy or appendectomy; one followed hemorrhoidectomy.

In 1922, Elwyn and Girsdansky (10) reported an instance of massive collapse after a laparotomy for penetrating stab wound of the abdomen. In the same year Hirschboeck reported three cases, all following abdominal operations.

In 1922, Cutler and Hunt (12) made a very painstaking study of post-operative pulmonary complications. They mention massive collapse as a possibility but assert

that it never has been observed in their experience.

In 1924, Regan (11) reported a case where collapse followed poliomyelitis.

In 1924, Ritvo (13) published a very complete study of the subject, with special emphasis on the X-ray findings, and added one case.

In January, 1925 (14), Scott made a complete study of all reported cases. Aside from war wounds, he found 64 reported cases in the literature, only 36 of which were reported in sufficient detail for analysis; to these, he added four cases. These latter were all post-operative and did not vary materially from those previously reported.

In September of the same year Chevalier Jackson and Walter E. Lee (15) showed the relationship between massive collapse and obstruction of the bronchi by foreign bodies or secretion.

From a consideration of the reported cases the clinical picture most frequently encountered may be described. The onset is usually quite sudden within the first twenty-four hours after operation or trauma, with dyspnea and rapid pulse. The patient rapidly becomes cyanotic, the temperature is irregular and may reach even 102°. The sputum is at first scanty, but later becomes thick and mucopurulent. It is never bloody nor of a prune juice type. The white blood count is somewhat higher than normal, and, with the appearance of mucopurulent sputum advances steadily, reaching as high as 20,000.

Other instances have been reported in which the pulmonary symptoms were entirely overshadowed by the exciting trauma. In such cases there may be little, if any, embarrassment of respiration or change in pulse rate or temperature, the collapsed condition of the lung being found only incidentally during examination. The duration is usually one to three weeks. The condition may terminate rapidly by sudden reinflation of the lung and re-establishment of respiratory function, or may require several weeks for complete recovery.

The process must develop very rapidly, since in all instances where radiographs have been taken, complete consolidation was present at the time of the first radiograph. In one of our cases, however, a radiograph was obtained before consolidation had occurred. The area subsequently involved showed slight haziness and some increase in peribronchial markings, but was otherwise apparently normal. There was slight deviation of the trachea toward the side subsequently affected, which was not considered of importance at the time. The significance of these findings will be discussed later.

With the advent of consolidation the characteristic picture appears: dense lobar consolidation or massive consolidation of an entire lung, homogeneous in character or only slightly mottled, displacement of the heart, trachea and other mediastinal structures toward the involved side, narrowing of the side of the chest involved and of the interspaces, and elevation and immobilization of the diaphragm. The lung may regain its normal aëration rapidly, even within a few minutes. If this is the case, the radiograph will show the re-establishment of the normal aëration at once. However, the condition may clear gradually, showing an irregular re-establishment of the respiratory function over a period of several weeks.

Very few patients die as a direct result of massive collapse so that only a few autopsies are recorded from which the true character of the pathology can be determined. Pasteur (1) was able to demonstrate atelectatic collapse of the lung in five of eight autopsies where the collapse followed post-diphtheritic paralysis of the diaphragm. However, he failed to find any bronchial obstruction or other lesion which would have been concerned in causing the collapse. He noted a fibrinous deposit over the diaphragm and pleura. Bradford (7), Briscoe (8) and

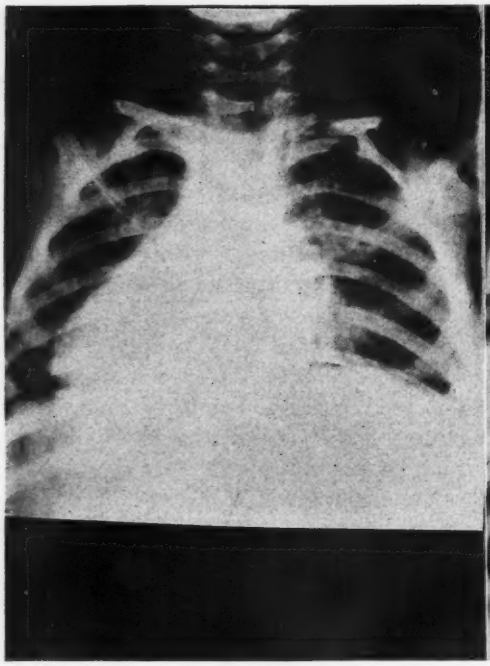


Fig. 1, Case 1. Radiograph taken March 14, 1926. No consolidation or collapse was present at this time, but slight deviation of the trachea toward the involved side was already present.

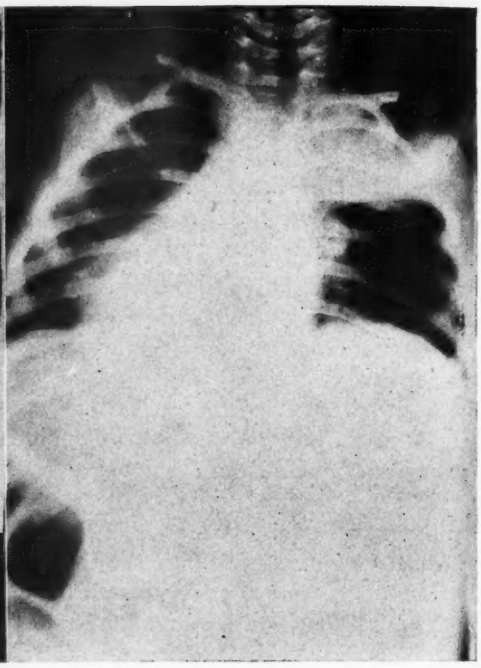


Fig. 2, Case 1. Within thirty-six hours dense consolidation of the right upper lobe had developed. Note deviation of the trachea, but relatively slight displacement of the heart.

others have made similar autopsy observations in cases following wounds and abdominal operations. From these confirmatory pathological and clinical observations there can be no doubt of the existence of massive atelectatic collapse as a definite clinical entity.

I would like, at this point, to describe three additional cases which have come under our observation, not only on account of the rarity of the condition, but also because each case has certain features which are somewhat unusual.

Case 1 (occurred in service of Dr. W. T. Coughlin, to whom I am indebted for this report). E. R. K., white, male, aged 5 years, entered the hospital the evening of February 10, 1926, with a history of having been suddenly seized with cramping pains in the abdomen.

Nothing in the past history was significant and the only complaint was of intense crampy pains in the abdomen and leg, which had come on a few hours before entrance.

Physical examination revealed pain on pressure over the right lower quadrant of the abdomen and a definite rigidity of the abdominal muscles. Nothing pathologic was found elsewhere. There was "no pain in the chest, no dyspnea, no symptoms referable to respiratory or cardiac system." The patient was operated on the next morning, February 11, 1926, under ether anesthesia and the appendix removed through a right rectus incision. The appendix was large and swollen, the end was bulbous and ruptured during removal, allowing a small amount of pus to escape into the peritoneal cavity. A definite localized peritonitis was already

present, and a small amount of pus was present in the peritoneal cavity.

The wound was drained and dressed, the patient put to bed, and after a few days rallied and was doing nicely. Drainage became less, drain was removed and wound granulated nicely; on March 4th, patient was permitted to go home.

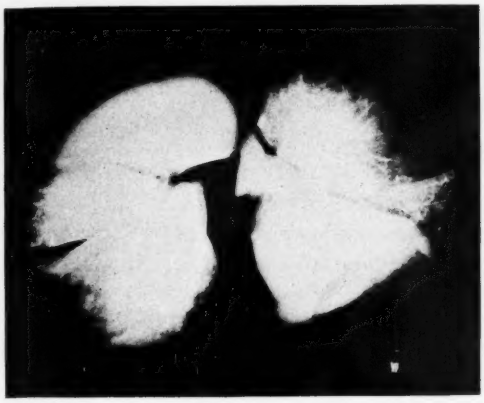


Fig. 3, Case 1. X-ray of postmortem specimen. Note density of atelectatic lobes as compared with aërated lung. Right upper and both lower lobes were atelectatic at autopsy.

March 12, 1926, he was re-admitted on account of high fever, 103.5° to 104°. The respiratory rate was high, but there was nothing which would indicate pathology in the chest. Examination of the wound revealed some pus and a grayish white membrane. Microscopic examination of the pus showed diplococci, and blood culture showed streptococci. March 14th, an X-ray examination was made of the chest (Fig. 1), not because of any definite physical signs or symptoms, but to determine any possibility of an associated septic pneumonia.

Some increase in peribronchial markings was noted, but there was no consolidation of the lung or other indication of pathology. The trachea showed slight deviation to the right, but this was not considered, at the time, of any pathologic significance. A second examination was made within thirty-six hours after the first (Fig. 2), which revealed dense consolidation confined to the right upper lobe, with retraction of the trachea toward the involved side. The chest wall showed very little narrowing at that time, and the heart was not definitely displaced. The patient continued to grow worse, running a typical septic course and the pulmonary collapse spread to involve the right and left lower lobes. Nothing, other than pronounced cyanosis, was present, which could be attributed to the lung involvement. The patient died March 19, 1926.

Extracts from autopsy report by Pathology Department of St. Louis University: "The lungs do not fill the pleural cavity when the chest is opened. There is a very marked fibrinous exudate throughout both pleural cavities.

"The right lung shows almost complete atelectasis of the upper and lower lobes [Fig. 3]. The middle lobe is relatively increased in size and is rather edematous. The left lung shows atelectasis of the lower lobe and an apparently normal upper lobe. On section, there is no gross evidence of infection, but the lungs exude quantities of blood and fluid.

"Microscopic sections of the lungs show complete atelectasis without cellular reaction; other sections show normal expansion of alveoli, with edema and bronchitis and early bronchopneumonia."

The points of special significance to be considered in this case, are: (1) The fact that massive collapse of the right upper lobe did not occur until thirty-three days after the operation and was probably incident to the general septic condition rather than to the operative procedure. (2) The slight deviation of the trachea *before* consolidation had occurred. (3) The fact that at autopsy, on opening the chest cavity, the lungs did not completely fill the cavity, and the chest wall assumed its normal position.

Case 2 (occurred in service of Dr. J. G. Probstein, to whom I am indebted for this

report). O. B., white, male, age 16 years. Entered hospital May 9, 1926, with a history of having suddenly developed an aching pain in the region of the left hip two days previously, which had become steadily

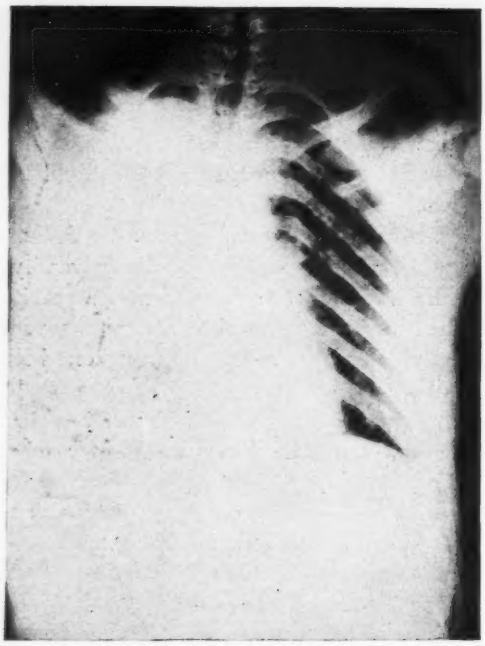


Fig. 4, Case 2. No definite injury. Complete collapse of the entire right lung. Note shallowness of the chest on the affected side, narrowing of the interspaces, and elevation of the diaphragm. The heart and trachea are displaced toward the affected side.

worse until he was unable to stand. The pain came on shortly after an afternoon spent in high jumping, an activity to which he was accustomed. The patient stated that he was sure no injury had resulted,—he did not fall or strike his body in any way. Shortly after the pain developed in the hip, the patient vomited, and, on entrance, could not stand, owing to the pain in the hip. Temperature 101.6°, pulse 80, respiration 24, W.B.C. 11,200 on entrance.

Nothing in past history was found which could have any bearing on the case. With the exception of a small abscess in the left popliteal space some two years before, there was nothing unusual in the past history.

Physical examination revealed a marked tenderness on pressure over the upper half of the left buttock, "probably, though not necessarily, involving the innominate bone." It was thought at the time that this might be due to a beginning osteomyelitis, since the white blood count was increasing. X-ray examination, however, was negative. White blood count: on admission, May 9, 1926, 11,200; May 10, 14,800; May 11, 15,200; May 14, 18,000.

May 12th, there was some evidence of physical findings in the chest and on May 14th, a radiograph (Fig. 4) revealed complete collapse of the entire right lung, with retraction of the heart toward the involved side; narrowing of the chest on this side and elevation of the diaphragm. Fluoroscopic examination revealed an immobilization of the diaphragm, on the involved side, and a rather hyperactivity of the other.

Fluoroscopic examination three days later revealed little, if any, change in the condition. The patient could not sit up on account of pain in the hip, so he was rolled over on the sound side and fluoroscoped in this way. On rolling the patient upon his back for radiographic examination, he complained of sudden pain in the chest, his respiration became shallow and pulse rapid. A cold sweat broke out all over his body. A radiograph was made and it was found that within the few minutes' time elapsing between the fluoroscopic and the radiographic examinations, the entire lower portion of the lung had again expanded and showed apparently normal aëration. The upper portion was still collapsed, however (Figs. 5 and 6).

The hip condition continued to improve without treatment after this, and on discharge there was little, if any, pain. The lung continued to expand gradually. Examination of the patient three months later (Fig. 7) revealed normal expansion and free diaphragmatic movement. The hilus shadows were still pronounced and several

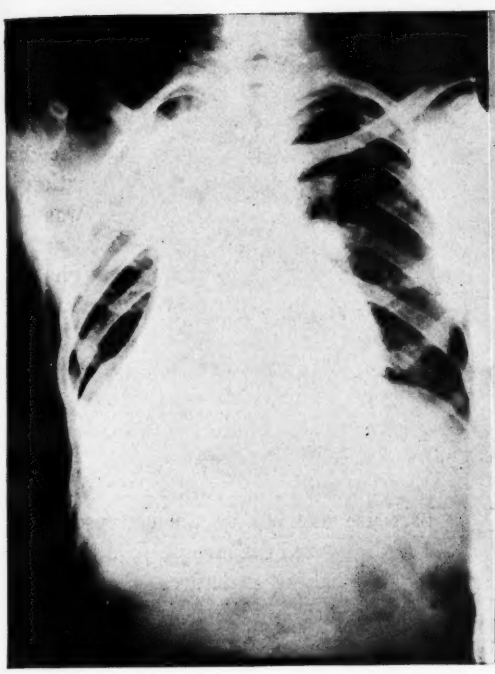


Fig. 5, Case 2. Fluoroscopic examination three days later still showed complete collapse. On rolling the patient over for the radiographic examination the lower lobe suddenly re-inflated. The time which elapsed between complete consolidation and re-inflation of the lower lobe was less than five minutes.

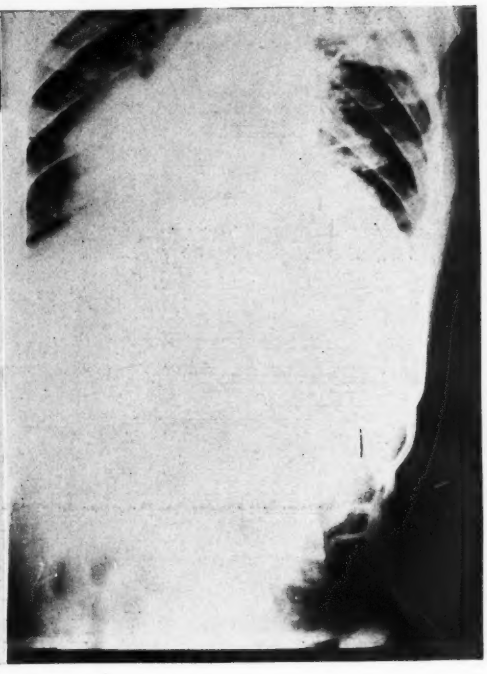


Fig. 6, Case 2. Second exposure made a few minutes after Figure 5, with patient lying on his side, showing unmistakable evidence of inflation of the lower lobe due to change in position.

rounded structures suggestive of enlarged hilus glands were present. The temperature ranged from 98.6° to 102°, usually not exceeding 100.6°. It was irregular, and normal at some time every day. There was no fever at all after the third day. The significant points in this case are: (1) The fact that the condition came on without any wound whatever and without any definite injury; (2) the suddeness with which expansion was re-established in a large part of the lung merely by rolling the patient upon his side.

Case 3 (occurred in service of Dr. John Stewart, to whom I am indebted for this report). J. O'C., white, male, aged 30. Entered the hospital September 16, 1926, for kidney fixation operation. His previous symptoms had been entirely referable to the urinary tract. Examination of the chest previous to operation failed to show any evidence of pathology. Kidney fixation operation was done September 18, 1926, under ethylene-ether anesthesia. The post-operative healing of the wound was uneventful, but there was some elevation of the temperature. On September 25th, the seventh post-operative day, the patient developed a slight cough and his temperature rose as high as 102.8° F. The white blood count at this time was 8,250. Physical examination, made by Dr. Ralph Kinsella, revealed, "dullness in the left upper lobe, anterior and posterior. Whispered voice sound not increased over this area. Sonorous râles and whistles over the right chest, anterior and posterior. Pericardial friction rub heard over one inch lateral to the nipple on the left. Dullness over the left, marked involvement of the entire side." Massive collapse was

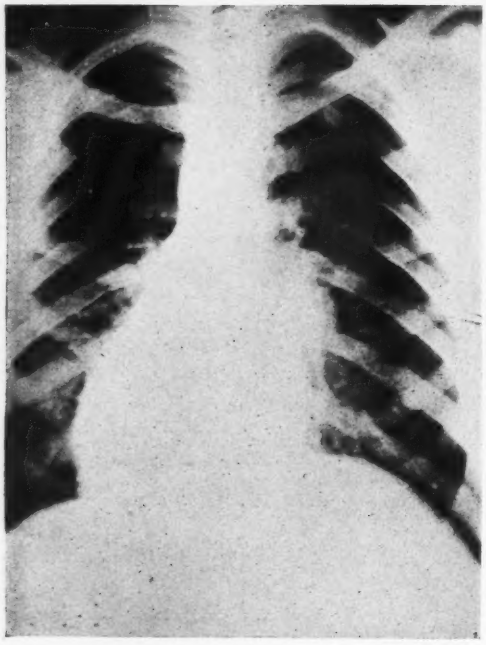


Fig. 7, Case 2. Condition three months later, showing complete recovery.

suspected and this diagnosis was made prior to X-ray examination.

On September 26, 1926, the first radiographic examination was made (Fig. 8) showing a dense homogeneous consolidation involving the entire left side, with narrowing of the chest wall, elevation of the diaphragm, and retraction of the heart and trachea toward the involved side. Bronchoscopic examination failed to reveal any foreign body, but a quantity of mucus was evacuated. Following bronchoscopy (performed by Dr. I. D. Kelly), the patient was rolled over on the uninvolved side and instructed to cough. Immediately the lung began to inflate under direct fluoroscopic vision (Fig. 9), starting first at the costophrenic angle and periphery of the lower lobe, which was soon followed by some inflation of the medial border also. Simultaneous with re-inflation of the lung, the interspaces became wider, and the mediastinal structures assumed a more natural position. After this, the condition progressed rapidly to re-inflation, and, with the exception of a small area of atelectasis in the upper lobe, the entire lung was re-inflated within seven days (Fig. 10). However, even at this time, fluoroscopic examination of the diaphragm revealed complete immobilization in a high position. The diaphragm was not paralyzed, there was no paradoxical action, —it was simply immobilized in a high position. The patient went on to an uneventful recovery.

From a consideration of all reported cases four hypotheses have been advanced as possible explanations of the cause of the condition.

1. That the collapse of the lung was due to pressure exerted by the collapsed chest wall and elevated diaphragm resulting from paralysis of these structures. That the resulting sluggishness of respiration permitted collection of secretion in bronchioles which caused this obstruction and the air remaining in the alveoli of the obstructed area was absorbed by the circulating blood. In other words, the pressure of the chest wall and diaphragm was considered primary, the lung collapse secondary. (Supported, especially by Pasteur.)

2. "That, due to the onset of inflammation affecting the muscles of the crus situated behind the peritoneum, one-half of the diaphragm and its synergistic and antagonistic muscles are out of action owing to inflammation of the muscle or the pleural membrane covering it." This results in a disturbance of the respiratory function, which, in turn, leads to collapse. (The view held by Briscoe.)

3. That obstruction of the bronchioles by secretions is the entire explanation, such a condition being all that is necessary for all of the other features of the condition, any disturbance of the respiratory function being incidental. (Observation of Jackson and Lee.)

4. That some spasmodic reflex of the bronchioles causes them to become occluded,

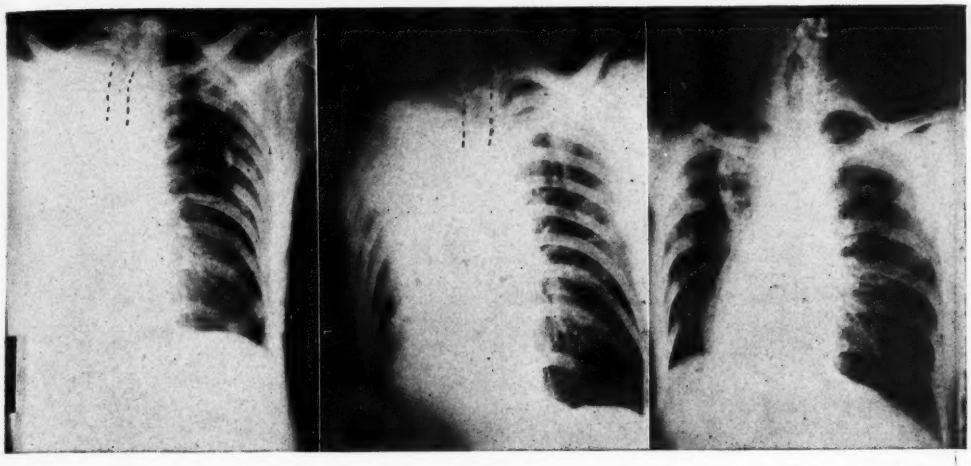


Fig. 8, Case 3. On the seventh post-operative day after kidney fixation operation, patient complained of pain in chest, and cough. Radiographic examination made at this time showed dense consolidation of entire left chest, approximation of interspaces and narrowing of chest cavity, displacement of trachea and heart toward involved side.

Fig. 9, Case 3. Mucus was evacuated by bronchoscopy. No immediate result was seen. On turning patient over on affected side, and causing him to cough, the lung began to inflate immediately while still under our fluoroscopic vision. Note the return of the trachea almost to midline and the widening of the interspaces as inflation progresses.

Fig. 10, Case 3. Condition seven days later, showing almost complete re-inflation of the left lung; small uninflated area remains in upper lobe. Mediastinum and heart have returned to their normal position. The diaphragm still remains high and is immobile.

permitting the subsequent absorption of air in the segment of the lung involved. (Explanation advanced by Sir J. R. Bradford.)

What is there in clinical observations, pathologic findings, or experimental evidence to support or contradict these theories?

1. Pasteur's original contention that this condition was brought about by paralysis of the diaphragm and other respiratory muscles, causing pressure and resulting in an atelectatic condition of the lung, is not borne out by the facts. In tuberculous individuals when phrenectomy has been performed as a therapeutic measure with a view to resting an involved lung, the condition has never followed (Fig. 11). Likewise, radiographic observations made on Case 1, before consolidation, revealed only very slight retraction of the trachea at least thirty-six hours before the presence of consolidation was definitely established, and before there was any restriction of respiration at all, showing that respiratory paralysis cannot be considered as a factor in the production of the collapse. The fact that at autopsy, on opening the chest cavity, the chest wall assumed its normal contour, and that the lungs failed to fill the entire cavity is of significance. If the collapse were due to pressure of the chest wall from paralysis of the respiratory muscles, the lung should have completely filled the chest cavity at autopsy. There is, likewise, no experimental basis for considering the pulmonary collapse as secondary to paralysis of respiratory muscles. Elliott and Dingley (4) performed experiments on rabbits, sectioning the phrenic nerve and other nerves influencing respiration, and never witnessed the phenomenon as a result of their experiments. Briscoe (8) has sectioned the phrenic nerve with the same results and has attempted to secure reflex inhibition by irritation of the peritoneum, stimulation of vagus nerve, etc., all without results.

We must conclude that there is no clinical, pathologic, or experimental basis for the theory that massive collapse of the lung fol-

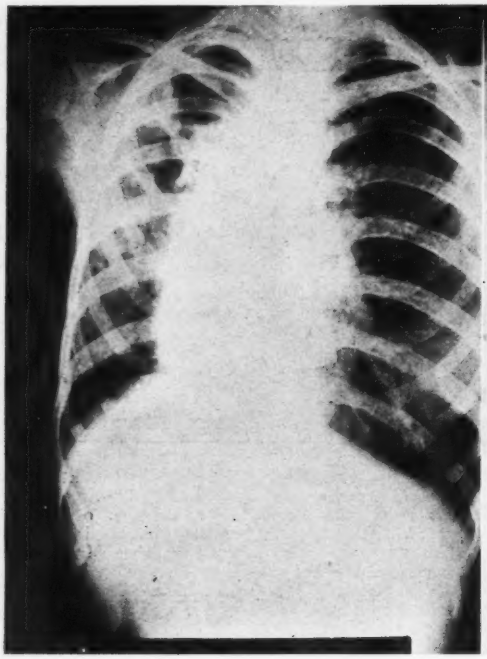


Fig. 11. Paralysis of the diaphragm from section of the phrenic nerve performed for the treatment of tuberculosis. No instance of massive collapse of the lung has been noted in such patients.

Fig. 12. Atelectasis of the upper lobe following complete occulsion of a bronchus by a primary tumor. This condition cannot be considered as a similar pathologic process to that cited above.

lows paralysis of the respiratory muscles. Briscoe's theory that collapse is produced by a lack of synchronism between the diaphragmatic movements brought about by retroperitoneal infection of the crus of one or other diaphragm, cannot be upheld, since, at best, it would explain only abdominal cases in which infection had occurred. Many cases have been cited in which collapse followed trauma (gunshot wound) so rapidly as to make infection impossible. His conclusion that the fibrinous deposit found over the pleura and diaphragm was due to infection is hardly tenable, inasmuch as the same condition has been described by Lichtheim (16) in experimental animals, after causing collapse of the lung within twenty-four or forty-eight hours by occlusion of the bronchus. There was no possibility of infection in this case. The fibrinous deposit is probably due to inactivity of the lung. It was noted in Case 1, following septicemia, but could not be demonstrated radiographically in our spontaneous case, even immediately after a sudden re-establishment of respiration in a large part of the lung. One would think that if a heavy fibrinous deposit were present it would have been seen in the X-ray examination, immediately after re-inflation; absorption would have been impossible, owing to the short time which had elapsed. The theory of infection of one of the leaves of the diaphragm can hardly be substantiated by the clinical, pathologic, and experimental observations.

Bronchial obstruction by secretions alone is the cause suggested by Jackson and Lee. It is undoubtedly true that a similar atelectatic condition of the lung may follow the lodgment and complete obstruction of a bronchus by a tumor or foreign body (Fig. 12). If the obstruction is not complete,

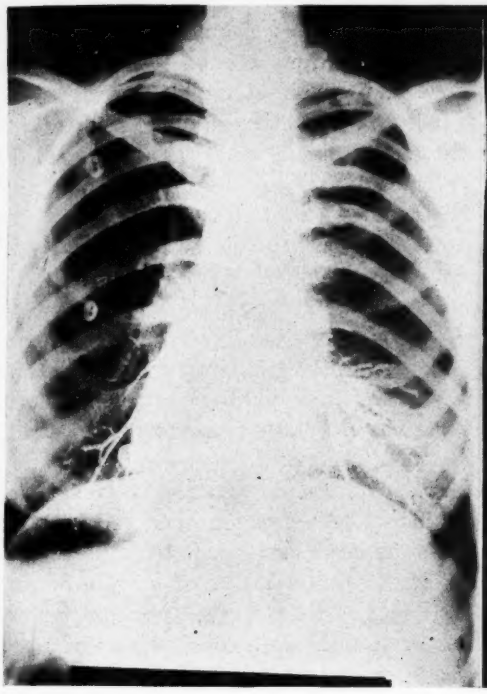


Fig. 13. If the bronchioles can be sufficiently obstructed by secretions, one would think that massive collapse should occur in patients in whom, on account of some toxic condition, the tracheal reflex had been lost. This patient aspirated barium, medication and food material for several days as a result of the intoxication incident to an intestinal obstruction. No atelectasis developed.

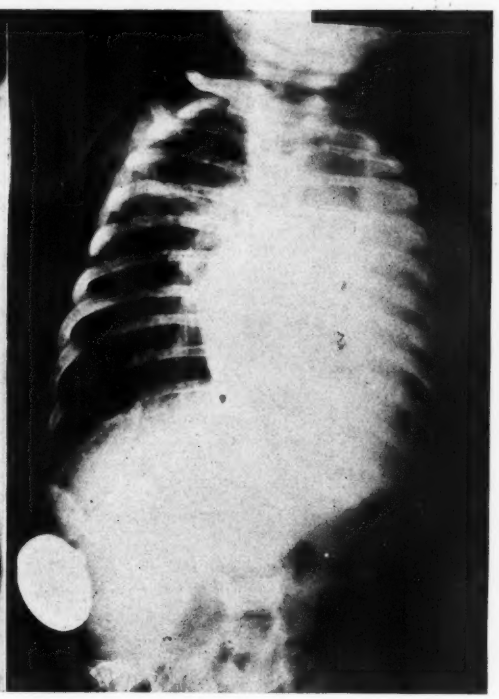


Fig. 14. The term "massive atelectatic collapse of the lung" should be reserved for instances where previously well aërated lung undergoes sudden collapse without bronchial obstruction or other apparent cause. This film shows practically the same X-ray findings, but the condition is one of congenital atelectasis.

however, complete collapse does not necessarily follow. Radiographically, the collapsed area has a mottled, irregular appearance, not the homogeneous density of massive collapse. It is rather hard to conceive of secretions causing such complete obstruction as to totally block off the lung from ventilation, in view of numerous radiographic observations where patients in extremely toxic condition from intestinal obstruction or some other such grave disorder, have lost their tracheal reflex and aspirated barium into the lungs in large quantities so that, days after, residual barium could still be seen (Fig. 13). If aspiration of secretion alone could cause sufficient obstruction to produce collapse, one would think that collapse should occur frequently in such cases. Likewise, no case has ever been reported following tonsillectomy. No case has ever been observed at autopsy in which any obstruction was found in the bronchioles. This theory must likewise be rejected since it does not cover all of the possibilities and lacks pathologic confirmation.

The last theory, advanced by Bradford (7), that the collapse of the lung is brought about by a reflex stimulation of constrictor nerve fibers to the muscles of the bronchioles or some such process leading to their occlusion, remains still to be considered. Clinically, the suddeness of onset, and radiographically, the uniformity of the involvement, suggest some such concerted action of

all of the bronchioles. All cases reported have followed either some toxic condition such as diphtheria, poliomyelitis, streptococcus septicemia or some insult to the nervous supply of the vagus; abdominal or

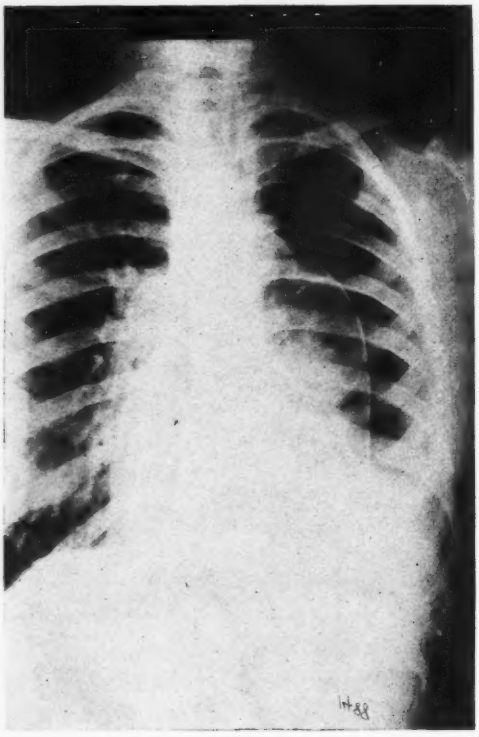


Fig. 15. Why the atelectatic lung shows such great density in the X-ray in contrast to the almost transparent structure of lung collapsed to even smaller size from pneumothorax, is difficult to understand and has never been successfully explained. Compare the transparency of lung here shown, collapsed from pneumothorax, with density of atelectatic collapse seen in other radiographs.

chest injuries or operations. Any one of these conditions could serve as the necessary reflex stimulus to constrictor fibers of the bronchioles. Pathologically, everything indicates that the collapse of the lung is primary and the drawing in of the chest wall, pulling upward of the diaphragm, and displacement of the mediastinum are secondary features caused by the loss of air content of the lung and consequent contraction of the lung substance into a smaller space. Experimental evidence of the existence of such constrictor nerves and muscle fibers in the bronchioles strong enough to produce complete and prolonged constriction, is found (17). That prolonged contraction of the constrictor muscle fibers of the bronchioles would not be necessary to produce this sequence of events is conceivable; the walls of the bronchioles, once collapsed, could be held in this state merely by cohesion, the absorption of alveolar air by the blood stream taking place rapidly. Once collapsed, the lung might remain in this state for a long time, until some unusual movement caused the breaking of the cohesion between the opposed surfaces of the bronchioles and alveoli, resulting in rapid re-inflation. The formation of secretion would accomplish the same result, but more slowly, allowing small amounts of lung to become inflated at a time, as the secretion was expectorated. From a consideration of all of the clinical, pathologic, and experimental observations, it seems that this is the most rational explanation of the condition.

SUMMARY

1. Massive atelectatic collapse of the lung is a definite clinical entity. This name should be reserved for cases following out the general clinical course herein mentioned where there is collapse of the previously well aërated lung. Congenital atelectasis (Fig. 14) should not be so considered.

2. It is characterized by sudden collapse of one or more lobes in a lung previously well aërated, from some unknown cause.

3. It is most frequently observed after abdominal operations, wounds, and other injuries such as fractures of the pelvis or femur, but may follow apparently trivial injuries.

4. Radiographically, there is a dense consolidation corresponding to one or more lobes or to an entire lung, rather homogeneous in character and resembling consoli-

dation from pneumonia. The narrowing of the chest on the involved side, approximation of interspaces, elevation of diaphragm and the drawing over of the heart and mediastinal structures, makes the condition readily diagnosable.

5. The cause is not known, but it seems most probable that some infection or insult to the region of vagus supply produces a reflex action on the bronchioles, permitting their temporary collapse. Once approximated, the walls of these bronchioles are held in apposition by cohesion, collapse of the lung rapidly following, owing to absorption of the alveolar air by the circulating blood. Relief of the obstruction results in sudden re-inflation of the lung.[2]

---

[2]See following issues of RADIOLOGY for discussions of papers read at the Annual Meeting, Nov. 29–Dec. 4, 1926.

REFERENCES

1. PASTEUR, W.: Internat. Jour. Med. Sci., Sept., 1890, p. 242.
2. IDEM: Royal Col. Phys., Bradshaw Lecture, 1908.
3. IDEM: Brit. Jour. Surg., 1914, I, 587.
4. ELLIOTT, T. R., and DINGLEY, L. A.: Lancet, Vol. I for 1914, p. 1305.
5. HOLMES, GEORGE W.: Am. Jour. Roentgenol. and Rad. Ther., June, 1924, XI, 509.
6. CRYMBLE, P. T.: Brit. Jour. Surg., 1918, V, 363.
7. BRADFORD, SIR J. R.: Oxford Loose Leaf Medicine, 1920, II, 127.
8. BRISCOE, J. C.: Quart. Jour. Med., 1920, XIII, 293.
9. SCRIMGER, F. A. C.: Surg., Gynec. and Obst., June, 1921, XXXII, 486.
10. ELWYN, H., and GIRSDANSKY, J.: Jour. Am. Med. Assn., Aug. 26, 1922, LXXIX, 718.
11. REGAN, J. C.: Lancet, Vol. II for 1924, p. 1222.
12. CUTLER, E. C., and HUNT, ALICE M.: Archiv. Int. Med., April, 1922, XXIX, 449.
13. RITVO, MAX: Am. Jour. Roentgenol. and Rad. Ther., April, 1924, XI, 337.
14. SCOTT, W. J. M.: Archiv. Surg., January, 1925, X, Part I, 73.
15. JACKSON, CHEVALIER, and LEE, WALTER E.: Ann. Surg., September, 1925, LXXXII, 364.
16. LICHTHEIM: Arch. f. exper. Path. u. Pharmakol., 1879, X, 54.
17. LONGET, M.: Compt. Rend. Heb. des Sci., 1842, XV, 500.

THE MALPRACTICE INSURANCE QUESTION

By I. S. TROSTLER, M.D., F.A.C.R., F.A.C.P., CHICAGO

IT is quite evident to any one who has practised medicine—and especially radiology—for any considerable time, that insurance against and indemnity guarantee for malpractice lawsuits is almost as necessary as is a license to practise.

Malpractice suits are unusually distasteful because they are attacks upon our professional reputations, and reflections upon the entire medical profession as well as—most especially—upon the defendant in the case.

Medical malpractice is usually understood to mean unskillful practice or negligence on the part of the physician, when as the result of such unskillful or bad practice or negligence, death ensues, or the health, efficiency, or appearance of the patient is impaired. Thus, malpractice may be willful, negligent or ignorant, and in some cases criminal as well as civil suits may be brought.

Civil suits for the recovery of damages on account of injuries supposed or alleged to have been experienced as the result of willful negligence or of ignorance, are very common, and, unfortunately, cases depending upon alleged X-ray burns for the cause of the damage are becoming more and more frequent as the number of X-ray machines multiply and persons of more or less (usually less) experience and familiarity with their operation and with their effects, undertake to employ them.

In practically all other kinds of injury, error, or even apparently gross negligence, there may be found some plausible way out of the difficulty; but when an X-ray burn appears as the cause of the injury, things always look bad for the doctor who produced it.

It is true that the presence of an X-ray burn is very seldom a good and sufficient reason for charging malpractice, because we, as physicians, have every possible incentive to do the best we can for every patient with whom we come in contact. Our reputations and our very living depend upon this, even if our humanitarian instincts did not so guide us.

When suits are brought for alleged malpractice and damage resulting from X-ray burns, the number of verdicts against the defendants who inflicted the alleged burns are many times more than all the other verdicts for damages, in proportion to the relative numbers of suits brought, and likewise the verdicts rendered by courts and juries in X-ray burn cases are for larger amounts than are those for the ordinary run of medical malpractice cases.

With these indisputable facts and figures staring us in the face, is it not easy to see why some of the insurance corporations refuse altogether to insure X-ray workers against malpractice? Is it not equally clear why those insurance organizations who are willing to carry our risks against malpractice suits must charge the X-ray worker more than they charge the physician who does not use the X-rays at all? It seems to me that it is exactly parallel to making a fifty-year-old man pay more than a twenty-five-year-old man for a thousand dollar life insurance policy. The chance for loss is greater, and, besides that, *when there is a loss the amount is liable to be greater.*

No one is safe from these suits; no one is immune. Negligence, carelessness and lack of skill are charged against the most erudite, careful, and experienced radiologists as well as against the most ignorant tyros, who have just purchased an outfit and still believe all that the salesman told them.

The records of these lawsuits show that claims are made and suits are brought with the greatest of impartiality against the most skillful, the best informed, and most experienced of our profession. And while it cannot be questioned but that some of these claims and cases have real merit, and occasionally real damage has been done, the briefs, bills of particulars, judgments, and decisions of the lawyers and of the courts of this country record in unmistakable language that no matter how devoid of merit or justice, or how preposterous such claims may be, no matter how ridiculous their assumed basis in theory or fact, a very high degree of legal skill is necessary to protect the property and preserve the reputations of some of the most skillful, careful, and learned men of our profession.

For example, a few months ago I was called as a witness in a case in a neighboring State, where a physician had applied the X-ray to the dorsal surface of a man's foot. An ulcer developed on the plantar surface of that foot as the result of infection from the needle which was the cause of the X-ray examination. A malpractice suit, charging X-ray burn, was brought, $50,000 damages claimed, and *a verdict for $15,000* was rendered. Of course, this case will be appealed.

The files and records of medical malpractice cases show a degree of rapacity, ignorance and effort to get easy money scarcely equalled by the yeggs and highway bandits of these days. Shyster lawyers, who take cases on contingency bases, are frequently the incitors of these cases, and unkind, slighting or sneering remarks by unthinking physicians are far too often the cause of the beginning of this sort of trouble. They often utterly fail to remember that we are only mortal and that, as mortals, we as well as they are liable to err.

In the early days of radiology, some courts held that the X-rays were dangerous, and numerous liabilities were imposed for resultant burns, regardless of well established rules of law as regards care and skill required of physicians; but fortunately those days have passed, although there are still some very dangerous decisions being quoted and used as precedents in the trials.

One of the questions which confronts us is, how are we to obviate the present difficulty? Another and a very important one is, how may we avoid paying the high rates of the regular insurance corporations and still be protected?

It has been suggested that we organize a mutual insurance body among ourselves. Nearly every state medical society in this country helps defend its members against alleged malpractice, but I do not know of any one of these who would indemnify a member if damages were assessed against him. If we were to organize a mutual insurance body of our own, with the idea of defending and indemnifying for such cases, we would first have to satisfy the State in which we incorporate that we are on a sound financial basis; that we can pay if we lose. We would have to maintain offices with an expensive staff, etc., and all of this would cost money; and then, if we had one or two cases lost and had to pay out one or two sums like $10,000 or even half that, where would we be?

Insurance is a business, just the same as selling shoes or groceries or running a bank. Men who are in that business figure out what it costs to insure us. They know what it costs and they are not going to charge us more than a reasonable profit. They cannot afford to overcharge us because there is competition; but they have a right to a reasonable return upon their investment, and cannot furnish you with ten or twenty thousand dollars' worth of insurance unless they get something for it. They make it their business to know—and they have the means of finding out exactly—how much it costs, and they are certainly entitled to full credit for furnishing us real protection. Besides, if the profits were so large, other in-

demnity companies would be entering the medical malpractice line, instead of which, some of them have quit insuring physicians against malpractice.

If we did organize our own insurance body and, in addition, belonged to the state medical society which furnishes us defense or help in defense, how many of you would be satisfied with these two, and would rely upon them for defense and indemnity? *I, for one, would not,* and I venture to say that *75 per cent of you would not.* We would want the protection of some big, outstanding, well known organization. And that would mean that, instead of only one bill for insurance, we would have two or three.

But some of you will say that there are now in existence several reciprocal and mutual insurance and indemnifying organizations. That may all be true, but, having investigated them, permit me to caution you to look and test the ground thoroughly before you leap. I know of one so-called reciprocal insurance organization, which claims to furnish insurance against malpractice, to indemnify, etc., at less than the current rates, and which makes several more or less extravagant statements relative to what it claims to furnish, at the same time attacking several other insurance-selling organizations.

During the last twenty years I have spent considerable time studying the subject of medical malpractice and indemnity insurance, and during the past few months I have gone to considerable trouble to investigate reciprocal insurance bodies, the one just mentioned in particular. I have secured from authentic sources, information relative to the reputation for business integrity and financial standing of the concern in question, as well as the reputation of the principal officers of the institution. The result of this investigation is, in part, as follows: The concern is organized as a reciprocal or interinsurance corporation, *thus making each subscriber equally liable for all claims.* It conducts its business on the "attorney-in-fact plan," although in a letter which I have seen, signed by its secretary, it is stated that "This company is organized on a reciprocal basis but *does not operate on a reciprocal basis.*" In other words, the secretary of the corporation admits in writing over his signature that it does not function according to its own organic law or charter. We would not deal with a bank that was not being conducted according to its charter, and we should be equally or more careful regarding deals with an insurance company acting in that manner, because it is supposed to guard not only our money but also our reputations.

The president of the concern in question got his start in high finance by selling worthless corporation stock to his own father, thereby causing the father to fail and lose his little business. The father is now employed as a night watchman in a factory, while the son (the president of this concern) lives in a palatial residence in the same city. The first insurance venture of this man was some sort of saloon keepers' protection. This went to the wall when open saloons went out of fashion. Later he headed several other more or less "wildcat" insurance schemes, all of which failed. He subsequently organized a "professional men's building company," which consisted of a scheme for selling stock to physicians and dentists. The building was not built, according to the well laid plans, although the bilked physicians and dentists paid the freight in the usual manner.

The present concern was first tried out among advertising physicians (quacks), who, as a rule, are unable to secure desirable malpractice insurance in the regular indemnity companies; but, it seems, the quacks have too keen a knowledge of business methods to swallow the "sucker bait" offered by this much-claiming company, so more recently it is turning to the regular practitioners and pharmacists for its prey.

Any one insured in any sort of reciprocal insurance organization, or who may contemplate securing such insurance, will do well to investigate thoroughly and carefully, and to weigh well all the particulars.

In a recent decision handed down by the Texas Supreme Court, it was held that all members and subscribers of a reciprocal insurance exchange are liable to third persons as partners. The court said: "Any intended, or for the matter express, limitations among the members of their individual liability, could no more control the rights of third persons than could a similar agreement between the members of any ordinary partnership. The members of the association are individually liable because they are all principals, and, being principals, are bound in the same manner and for the same reason that members of an ordinary partnership are bound."

In a recent suit in Chicago, before the United States Circuit Court, Judge Wilkerson said: "The attorney-in-fact is merely the joint agent of the subscribers in carrying on their business of mutual insurance," and farther along in the same decision he referred to the interinsurance exchange, in this case the Associated Employers Reciprocal of Chicago, as "this joint undertaking."

In the case of the Associated Employers Reciprocal of Chicago, some 80,000 policy holders (subscribers) are facing assessments of from a few dollars to as much as $80,000. At least one thousand of these assessments are of more than $1,000 each, and, in Illinois alone, the total amount to be collected from policy holders (subscribers) in the final settlement is over $1,184,000, and the total amount to be collected from policy holders (subscribers) in the United States is something over $3,250,000. Some of the bills which these policy holders have had to pay date back to 1920—for six years.

In Wisconsin, the Attorney General for the State held, in a suit against a reciprocal insurance organization, that "The defendants (members) became, were and are jointly and severally liable."

So from the above showing, I am sure that we do not want that sort of protection, because the courts are deciding that subscribers or members or policy holders in the reciprocal or mutual plan of insurance are merely an ordinary group carrying on a business together, and that each and all, jointly and severally, are liable individually and collectively.

In addition to the financial liability, there are other reasons why we should keep clear of such entanglements. One of these reasons is that, if it were discovered that a physician appearing as a witness for the defense in a malpractice case, was insured in some group, mutual or reciprocal, that fact would be considered competent evidence as bearing upon the credibility of such witness, and would, of course, open the door for injecting the insurance question by legitimate means into the issues of the case: this in addition to the damaging effect of the evidence upon the jury's estimate of the trial issues, the defending physician and his witnesses.

The group plan of insurance, as introduced by one of the large insurance companies and in use by several others at this time, is likewise a dangerous plan for these same reasons.

In the case of Hoover *vs.* McCormick (247 S.W.R., 718), decided by the Court of Appeals of Kentucky, a verdict for $4,000 damages against the defendant physician was affirmed. In the decision by this Court much emphasis is laid upon the agreement between groups of physicians who are associated together for protection in defense of malpractice suits, whereby interest and bias could be shown to exist because of their association in and under such a contract as group insurance.

I have in my possession—among the files of documents connected with my present

studies of the insurance question—an application form of and to one of the largest insurance companies in this country, for group insurance, which states: "Each insured member (of this group) has agreed, if a fellow member is sued and the Company desires him to do so, to give expert testimony without charge for his time and services." If any attorney upon finding that the witness under examination was one of such a group, would merely introduce this form, even if it were not admitted as an exhibit in evidence, and thereby inject the insurance question into the case, it would most certainly play havoc with the credibility of the medical expert witnesses.

While it is recognizedly improper for the attorneys for the plaintiff in a malpractice suit to interrogate the physician defendant as to whether he has insurance against malpractice suits, it is proper for the same attorney to ascertain what interest, if any, a witness may have in the outcome of the suit, and it is in that phase of the examination of witnesses that the group, mutual or reciprocal insurance is dangerous; because it makes it possible for the other side to destroy and discredit the value and weight of expert testimony. This of itself is a serious matter, as it leaves all those so insured more than ever at the mercy of the unscrupulous, easy-money-getting patients and their equally (or more) unscrupulous lawyers.

It is not generally known by physicians that no question as to whether the defendant has or has not insurance, is permitted in the trial of a case. This has not yet been decided in a malpractice case in Illinois or Wisconsin, although it has been so decided in numerous other tort cases, where the plaintiffs were injured by automobiles, and there is little doubt but that the same rule would hold regarding medical malpractice. I understand that the question has been so decided in regard to medical malpractice in Kentucky, New York and Missouri, and that this rule has been held to apply.

None of us knows who will be the next to have one of these suits filed against him, so it behooves us all to be in the best possible position to help out colleagues and coworkers who have this misfortune, whenever and wherever it becomes possible to do so.

It is quite true that some of us may get through all right with the low priced insurance, even though it is acknowledgedly inferior, particularly as long as things run smoothly and no malpractice suits are filed against us, but it is very much like driving an automobile: When the roads are smooth and well paved any old rig will run along fine; but after a big storm, when the road is washed out, rutty and washboardy, or rough and bad, the wise driver has a big, sturdy car with balloon tires, and these roll along over the bad roads in ease and comfort. Likewise, do the men with good safe insurance rest in peace and comfort, while those with anything less than the best have cause to worry.

Naturally, the question arises as to how we may hope to induce good reliable insurance corporations to reduce their rates without reducing the amount and character of protection that we want. I am of the opinion that if we would officially classify the X-ray workers of this country we might be able to find some reliable and satisfactory insurance corporation that would be willing to accept our classification and formulate some sort of graded scale of rates therefrom. I do not know that any of the companies would do this, but it seems to me that some such plan might be worked out. It is certainly worth trying.

In closing, I would like to make an effort to specify what I think proper and adequate malpractice protection should be. *It should defend without limit,* and to the court of last resort, *any and all claims or suits* for damages for malpractice, mistake or error based upon services rendered by the insured,

his assistants, associates or his estate, when such services were rendered in the lawful practice of medicine, and it should *indemnify* the insured or his estate against any judgments or losses imposed by law for any and all the aforementioned causes. The organization contracting to furnish such insurance should have a *sound financial foundation,* and the officers and other persons in charge of the business should be of tried, known, and *absolutely unquestioned integrity.* The contract or policy should not in any way make the insured (or policy holder) liable for any more than the stipulated premium or consideration of the contract. Any exchange of indemnity between contractors, of the reciprocal or mutual type, *is not to be considered.* The above mentioned kind of insurance is *real insurance.* It is real and genuine protection. But it costs money to furnish it, and if we want it we must pay for it, just as we have to pay if we want to own a good automobile and negotiate the rough roads in ease and comfort. If we can get that kind of insurance at a lower rate than we are now paying, we will have done something toward solving the malpractice insurance question.[1]

---

[1]See following issues of RADIOLOGY for discussions of papers read at the Annual Meeting, Nov. 29–Dec. 4, 1926

PLAN AND SCOPE OF RADIATION THERAPY SERVICE AT BELLEVUE HOSPITAL, NEW YORK CITY

By IRA I. KAPLAN, B.S., M.D., Assistant Roentgen Therapist in Charge of Service, Bellevue Hospital, NEW YORK CITY.

THE need for caring for the numerous cases requiring radiation therapy from various services of this, the largest hospital in New York, has been the cause for the completion recently of the new Radiation Therapy Service at Bellevue Hospital. Containing over sixteen hundred beds for all types of cases, which are received in all possible conditions, this hospital naturally has a large percentage of patients who can be benefited by radiation therapy. Until quite recently, those requiring such treatment were sent to other institutions. Until a few years ago, under a temporary arrangement, a part of the Diagnostic Department was utilized as an X-ray therapy laboratory. However, during the past year, there has been provided at Bellevue a new, complete equipment for radiation by X-ray and radium.

The quarters first allotted for this consisted of two small rooms and one machine, and yet, in this small space, with inadequate machinery, 338 new patients were treated during the eight months prior to January, 1925. Then, as the various medical and surgical divisions of the hospital were made acquainted with the service that might be rendered by radiation therapy, the service expanded to such an extent that the space allotted for this work proved altogether inadequate. Accordingly, the present facilities were planned and constructed in 1925–1926.

These consist of one-half of the ground floor of a connecting wing of the "K" building of the hospital, in close proximity to the X-ray Diagnostic Department, and occupy about 3,000 square feet of floor space, directly accessible, via elevators and connecting hallways, to all the hospital wards and thus easily reached by both ambulatory and bed patients. The allotted space is divided into seven rooms: a general waiting room, two rooms for deep therapy, one for superficial therapy, one large consultation room, one office and examining room, and a minor surgery room where ambulatory radium therapy is carried on.

The deep X-ray therapy rooms are equipped with separate X-ray units, each of which is enclosed in a separate motor room off the treatment room. The generators are each capable of energizing two tubes at one

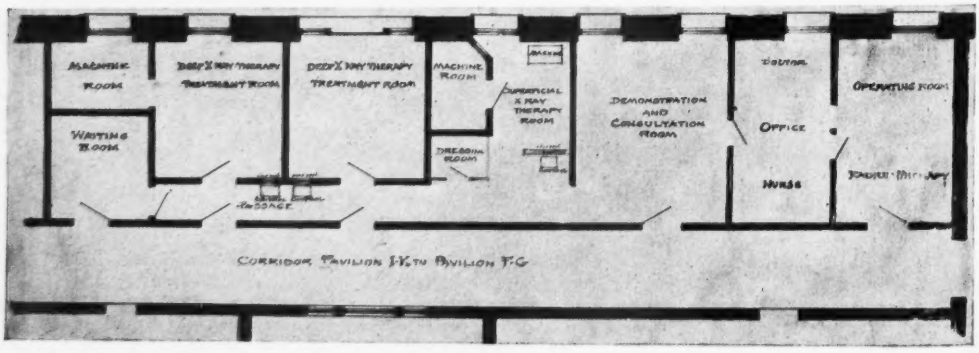


Fig. 1. Plan of Department.

time. One generator is of the high tension interrupterless type with two transformers, two discs turned by two synchronous motors. The other generator is of high tension, capable of producing 300 K.V., and has a single transformer, disc and motor, and is also of the interrupterless type. In each treatment room there are two treatment tables, so that one or two patients can be treated at the same time by each unit. In one room the treatment tables are stationary, with movable totally enclosed lead drum air-cooled tube stands. For superficial and medium therapy there is a separate room with a ten-inch interrupterless single disc machine, adjustable table, and open air type tube stand. There are also various sized treatment cones and filters, and a quantity of protective rubber shields.

The examining room is completely furnished for the necessary physical examinations, any minor surgery incident to radiation therapy, and for any incidental surgical dressings. It is also equipped with a new type portable Multotherm, with which endothermy operating is done.

7-1309-25 CK

(This card is not to be removed from the Dep't.)

BELLEVUE HOSPITAL

Radiation Therapy Department

NAME AGE OCCUPATION

ADDRESS

DIAGNOSIS

SYNOPSIS OF HISTORY

ESSENTIAL PHYSICAL FINDINGS ON ADMISSION

TREATMENT—

TYPE TECHNIC
DATE BEGUN DATE END
DETAILS

RESULT

PHYSICAL EXAMINATION AT END OF TREATMENT

OVER

Fig. 2. History card. Record of follow-up service is kept on other side of card.

The Therapy Service works in close co-operation with the Diagnostic Service, so that duplication of equipment for this work is unnecessary.

The layout, as indicated by the subjoined plan (Fig. 1), shows the very practical scheme of isolation of the generating plants, the entirely enclosed treatment rooms, private hallways, the control posts and nurses' positions. The walls of the treatment rooms are of barium plaster over fireproof brick construction. The doors are of lead-coated wood, and the observation windows of lead glass. Each treatment room opens on the outside through large windows, which amply furnish both light and air. Through the control and observation windows the nurse is entirely isolated from the rays, and comfortably views her patient during treatment without possible harm to herself.

Patients are received from the hospital, the dispensary, and from outside sources. After they are examined and a complete history taken, a plan of treatment is worked out for each patient. This, together with the necessary X-ray plates, photographs and report of the physical examination or any special examinations made, is filed for ready

7-1273-23-H. S.

THERAPY
BELLEVUE AND ALLIED HOSPITALS
X-RAY DEPARTMENT

Date.....

Name.....**Div.** {Surg.....{Ward.....
Med.....{O. P. D.....**A. O.**.....

Occupation ..... **Age**..... **Weight**.....

Resident .....**Attending** .....

Diagnosis ..... **Part**.....
(Right or Left)

History in brief (state principal symptoms).....

.....

.....

.....

.....

.....

State definitely what treatment is desired.....

.....

Organ .....

Disease .....

Fig. 3. Request for treatment card.

reference in the office of the service, on prepared special forms and cards (Figs. 2–6) for the various phases of the work. The patients are referred to this service for both benign and malignant conditions, covering the whole field of medicine. Patients are received in all stages and conditions of disease, and both curative and palliative treatments are given, according to the condition at the time of treatment. Each case is

7-1275-25-H

BELLEVUE HOSPITAL

X-RAY THERAPY DEPT.

Name .....

Address .....

Referred by .....

Diagnosis .....

Date					
Area					
Filter					
Portal Size					
Wave Length Volts-Max.					
Milliamp.					
Distance					
S. E. D.					
%S. E. D.					
Time					
Mill. Min.					

Dosage Formula

Fig. 4. X-ray therapy treatment card.

studied carefully in co-operation with consultants from the surgical, medical and pathological departments, and use is made of the form of radiation best suited to the particular case. In all cases where it can be done safely a biopsy is made, so that a histological diagnosis is used to confirm the clinical one.

In a general way the radiation technic used is as follows: X-ray radiation is given in divided doses over periods of time varying with the requirements of each case; radium treatment, a small dose over long periods of time. So far, this has proven to be the most advisable method. Endothermic treatment is carried out either in the department operating room or in the main operating room, in conjunction with the surgeons, when necessary. Local skin conditions are treated with the smaller machine, 7–9 in. gap, 4–5 milliamperes, filtered 1–3 Al. Benign conditions, tuberculous adenitis, pertussis, and inflammations are treated either with 9-inch gap, 4 milliamperes, 3 aluminum, or with the larger machine, 200 K.V., 4 milliamperes, 0.5 copper, 1 aluminum. Malignant conditions are treated with the high power apparatus, 200 K.V., 4 ma., 0.5 Cu. and 1 Al. The distance used and the size of fields vary with the condition to be treated. Gynecological malignancies receive a full course of deep X-ray treatment over the pelvis previous to radium therapy. Cases of tongue carcinoma are radiated with deep X-ray over the cervical gland areas before radium therapy is given. Carcinoma of the breast patients, when time is available, have a course of pre-operative radiation. All cancer of the breast cases operated upon receive post-operative radiation. In these cases high power X-ray therapy is employed.

7-1316-26-B

BELLEVUE HOSPITAL

TIME CARD

X-RAY THERAPY DEPARTMENT

Name.....

Date	AREA	Time		Total	%
		From	To		

Fig. 5. X-ray therapy time card.

Our cases are treated, wherever possible, by the multiple portal cross-fire method, with fractional dosage administered over alternate areas on different days. In malignant cases we try to administer the complete course of treatment in seven to fifteen days, and where radium therapy is subsequently required, this follows immediately after the X-ray treatment. Benign conditions are usually given one-eighth to one-quarter dose weekly per area. In radium therapy we use a modified form of the Curie method. In practically all cases, filtered radiation in platinum tubes or needles is used. In some cases, bare implants and filtered seeds are used. Inasmuch as the hospital as yet owns no radium, emanation is used exclusively in the radium therapy procedures. The emanation is bought from commercial sources as required. Efforts are being made to secure a radium emanation plant for supplying the demands of the radium branch of this service.

There were, during the year 1925, 596

7-1315-26-B

BELLEVUE HOSPITAL

RADIUM THERAPY

Name .....

Address .....

Referred by .....

Diagnosis .....

Position
Type

DIAGRAM

APPLICATOR
- Number
- Type
- Size
- Material
- Thickness
- Filtration
  - Primary
  - Secondary
- Protection
- Radiation
  - Element
  - Emanation

Where Applied

TREATMENT

ELEMENT					EMANATION						
Begin		End		Hours	Begin		Value	End		Value	Used	Hours
Date	Time	Date	Time	Used	Date	Time	Milc.	Date	Time	Milc.	Milc.	Used

TOTAL ELEMENT
- Time
- Dosage
- Time
- Dosage

TOTAL EMANATION
- Time
- Dosage
- Time
- Dosage

Fig. 6. Radium therapy record card.

X-ray cases, with 1,509 treatments given, and 80 radium cases, with 1,715 millicuries of emanation used. From May, 1924, until May, 1926, 1,201 X-ray cases were treated and 3,158 treatments given. There were 117 cases treated with radium and 2,857 millicuries of emanation used.

Upon the completion and installation of the planned-for new equipment, the work will be markedly increased.

Roentgenologic detection of calcified hypernephromas.—X-ray examination has been used with great success to detect kidney stones. The literature contains the reports of many things with which urinary stones may be confused. No report is found in the literature, however, of calcified hypernephroma. A review of the pathological findings at autopsies reveals numerous instances where hypernephromas were partially or totally calcified. The radiologists, when this fact is called to their attention, will undoubtedly detect more of these cases. A case is reported in detail where the tumor mass was large and irregularly calcified—almost laminated. The condition may be chronic.

L. R. SANTE, M.D.

Calcified Hypernephroma of the Kidney: Report of a Case Diagnosed by X-ray Examination; with a Discussion of the Differential Diagnosis of Renal Shadows. Aaron Arkin. Surg., Gynec. and Obst., August, 1926, p. 155.

FLUOROSCOPIC STUDY OF THE HEART

By ROBERT WILLIAM LANGLEY, M.D., Los Angeles, California
Attending Staff, Los Angeles General Hospital; Cardiac Consulting Board, Los Angeles City Schools

THE early diagnosis of cardiovascular diseases has been made possible with the introduction of instruments of precision. Among recent advances fluoroscopy and orthodiagraphy must be considered of paramount importance. At the beginning of the last century few expected that the X-ray would ever exceed the domain of surgery. Inestimable progress has been made, however, and one can now trace accurate images of the heart shadow in its various positions. Valuable information of pathological changes is thus obtained in one or several of the heart cavities and vessels at the base.

The technic of orthodiagraphy was first introduced into Germany by Moritz and later developed by Levy-Dorn, Grumach, Groedel, and others. More recently the work of Vaquez and Bordet has added much to its value as a clinical aid. In this country the work of Van Zwaluwenburg and Warren, Hodges and Eyster, Karshner and Kennicott, Wilson and Merrill, and Levi have contributed to the development and advance of cardiac fluoroscopy.

Only those methods which accurately reproduce the size of the heart are of value. These include teleradiography, orthodiagraphy, and fluoroscopy. Orthodiagraphy and fluoroscopy only will be considered here. These are important and give information as to (1) the respiratory displacements of the heart, (2) the respiratory excursion of the diaphragm, (3) the mobility of the apex, (4) the volumes of the left auricle and ventricle, (5) the character of the ventricular impulse, (6) the site of the auriculoventricular junction. These methods present a living document and give much valuable information in a brief examination.

The technic of orthodiagraphy is not difficult aside from the interpretation of the shadows which may be placed tangent to the heart border in any position. The shadow

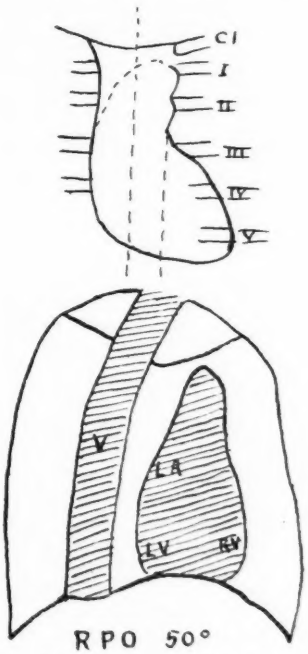
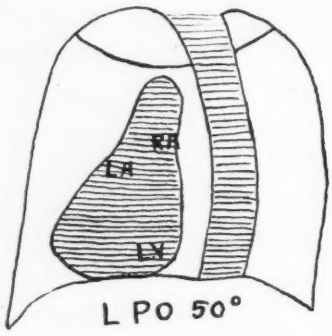


Fig. 1 (above). See text.
Fig. 2 (below). Right posterior, 50°. V, vertebral column; LA, left auricle; LV, left ventricle; RV, right ventricle.

cast by a ray tangent to the heart border is traced upon a paper or the fluoroscopic screen, thus giving an exact image of the heart outline. The heart shadow is studied thus in the direct anterior and posterior, lateral and oblique positions, with the patient in the standing position preferably.

In the anterior or frontal position the patient faces the screen, the plane of his body being parallel to that of the screen. In the oblique positions the right or left shoulder

touches the screen, the body forming an angle between 25 and 30 degrees with the screen. In the lateral positions the body forms an angle of 90 degrees with the plane of the screen.



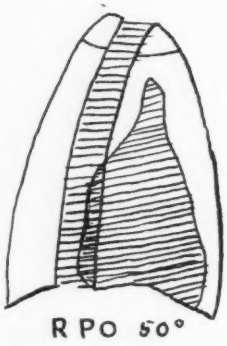
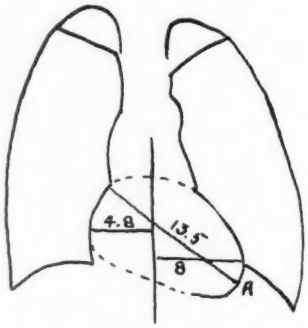


Fig. 3 (above). Left posterior, 50°.
Fig. 4 (below). Right posterior, 50°.

Several types of angle-finding devices are in use, among which the revolving platform type I find the most practicable. Here the patient may be turned at will and the angle of obliquity noted on the circular base board.

In the direct anterior (frontal) position the usual information to be obtained includes: on the right (left of the patient) (Fig. 1) the configuration of the arch of the aorta, the shadow of the pulmonary artery, the left auricle, the left auriculo-ventricular junction, the border of the left ventricle, the apex,—its character and position. On the left (right of the patient) one observes, above, the superior vena cava, and, below, the right auricle. By means of the above landmarks the longitudinal and horizontal diameters of the heart may be determined. The respiratory displacements of the heart, movements of the diaphragm, degree of mobility of the apex, and auricular and ventricular impulses may also be studied.



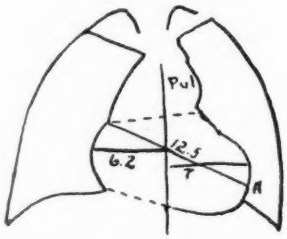
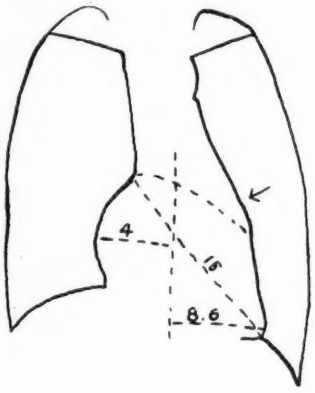


Fig. 5 (above). See text.
Fig. 6 (below).

In the oblique and lateral positions distinct information is obtained as to enlargements or abnormal developments (Figs. 2 and 3) of the auricles and ventricles. This is one of the most valuable features of orthodiagraphy.

In the lateral and posterior oblique positions a clear space is seen between the heart shadow and the vertebral column—the retrocardiac clear space, more or less distinct in the normal individual. If there is an increase in the size of the left auricle (as in

mitral disease), a distinct bulging into the upper third of this space will be seen, particularly in the right posterior oblique at an angle of 50 degrees. Likewise, enlargements of the right auricle may be distinguished in the left posterior oblique position as they encroach upon the retrocardiac clear space in its middle third. The left and right anterior oblique positions give confirmatory and added information to the above.



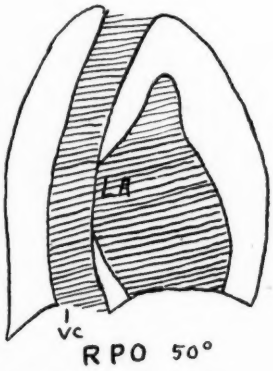
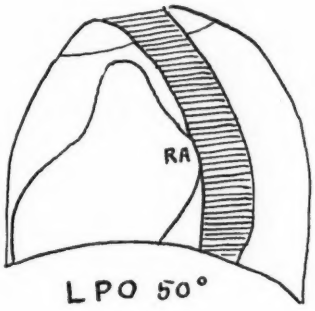


Fig. 7 (above). See text.
Fig. 8 (below). Right posterior, 50°.

Distinct types of partial or total enlargements will characterize different types of valvular disease, congenital lesions, gross enlargements from hypertension, myocarditis, etc. For example (Fig. 4), the angle of disappearance of the apex behind the vertebral column in the right posterior oblique position indicates the presence or absence of left ventricular enlargement. The apex is normally visible at an obliquity of 25 to 30 degrees. Visibility at 40–45–50 degrees indicates ventricular enlargement.



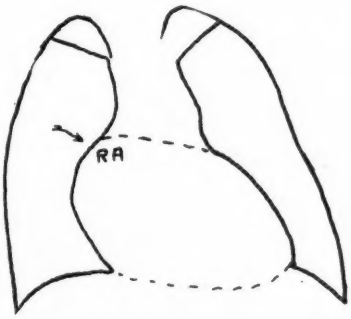


Fig. 9 (above). Left posterior, 50°.
Fig. 10 (below).

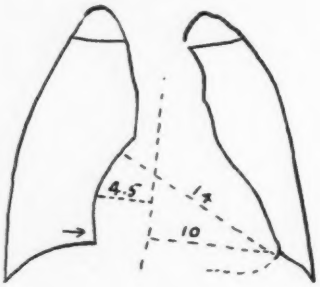
As mentioned previously, various diseases give rather characteristic outlines. Left ventricular hypertrophy (Fig. 5) gives the picture of a rounded apex below the diaphragm, longitudinal diameter definitely increased, while the horizontal is increased only slightly. Further, in the right posterior oblique position the apex disappears behind the vertebral column at an angle greater than 30 degrees.

Increase in the size of the right ventricle (Fig. 6) gives the typical sabot-shaped heart with the right side of the right ven-

tricle resting upon the diaphragm, thus dislocating the left ventricle and apex upward above the diaphragm.

Enlargement of the left auricle (Fig. 7) may sometimes be seen in the frontal position as it encroaches upon the space normally occupied by the pulmonary aorta. The information of greatest value (Fig. 8), however, is here obtained in the right posterior oblique position, where a prominent bulging into the upper third of the retrocardiac clear space is seen. Only a small luminous triangle of light remains near the diaphragm.

As described above (Fig. 9), enlargement of the right auricle is well shown in the left posterior oblique position as it encroaches upon the middle third of the retrocardiac clear space, but here also (Fig. 10) more valuable information may be obtained by examination in the direct anterior (frontal) position. A distinct bulging may be seen in the upper portion of the right contour at the position marking the junction of the vena cava (superior) and the right auricle.



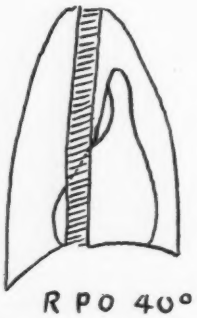
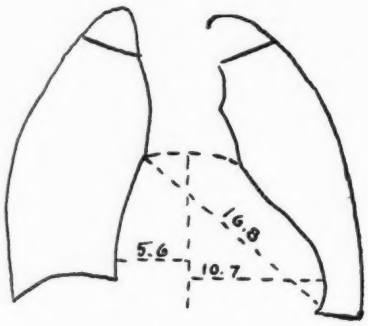


Fig. 11 (above). See text.
Fig. 12 (below). Right posterior, 40°.



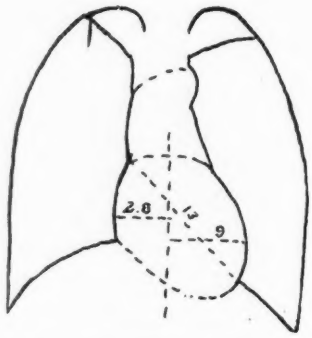


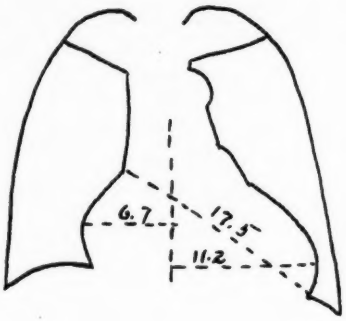
Fig. 13 (above). See text.
Fig. 14 (below). See text.

The presystolic impulse characterizes it as auricular in character.

Quite often it becomes necessary to determine whether or not a systolic murmur at the apex indicates functional or organic disease. The cardiac silhouette may become a valuable aid in these cases.

In organic mitral insufficiency (Fig. 11) the right side of the heart in the frontal position shows a distinct enlargement. One also observes, in the region of the arrow, an impulse which is clearly that of the right ventricle. The contour of the left ventricle shows slight left ventricular enlargement. This is further borne out by the fact that

the longitudinal diameter is definitely increased, while the horizontal only slightly surpasses the normal. In the right posterior oblique (Fig. 12) the left auricle is not enlarged but the apex disappears behind



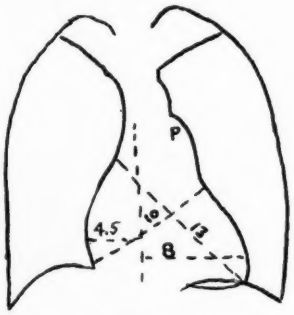


Fig. 15 (above). See text.
Fig. 16 (below). See text.

the vertebral column at an angle greater than 30 degrees, due to enlargement of the right ventricle and concomitant enlargement of the left also.

Taking next the condition of functional mitral insufficiency (Fig. 13), the contour of the left ventricle is usually more rounded than in the previous condition; the apex, instead of being sharp, is rounded; the left ventricular wall is more globular in shape, and finally there is not the same proportional increase in the diameters as found in organic mitral disease.

In aortic regurgitation (Fig. 14) the frontal position shows a heart rather vertical in type with a rounded apex which does not separate from the diaphragmatic shadow during deep inspiration. The left ventricle is enlarged and rounded in contour. The systolic impulse is quite forceful. Finally, the longitudinal diameter will be found to

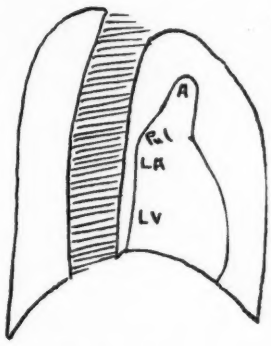


Fig. 17. See text.

be greater than normal while the horizontal will be less. In the right posterior oblique position the apex disappears behind the vertebral column at an angle much greater than the normal. One may conclude that there is left ventricular hypertrophy without visible evidence of other cardiac enlargement.

Aortic stenosis (Fig. 15) will give a picture similar to the above but generally shows an increase in the size of both ventricles and may have, in addition, evidence of enlargement of the aortic shadow.

CONGENITAL LESIONS

Orthodiagraphy may play the most important rôle in the diagnosis of these conditions. The diagnosis is quite simple where typical clinical signs are found. Orthodiagraphy is here the most important single aid and will render quite apparent the modifications due to these malformations.

Pulmonary stenosis (Fig. 16), when viewed in the frontal position, shows a prominent dilatation in the region of the pulmonary artery animated by a vigorous systolic impulse. The right border reveals

a decided increase in the size of the right ventricle.

In the right posterior oblique position, the contour of the left auricle (Fig. 17) and ventricle presents nothing. On the other hand, an encroachment into the retrocardiac clear space is seen in the region above the auricle and below the aortic shadow—the pulmonary artery. Turning the patient now into the right anterior oblique (Fig. 18), at an angle of 50 degrees, it will be seen that the right auricle and ventricle are increased in size as shown by their encroachment into the retrocardiac clear space. Pulmonary stenosis with (Fig. 19) interventricular communication will likewise vary the picture in a characteristic manner. The right and left contours of the heart are found markedly developed and rounded in character, giving a globular appearance to the organ. The apex is also quite rounded and indistinct.

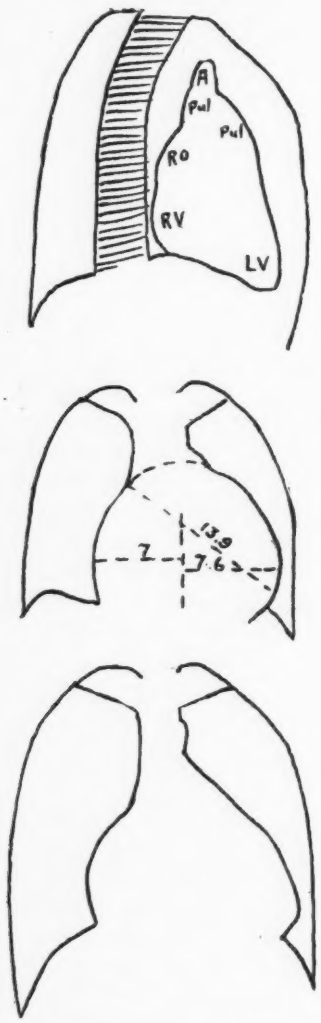


Fig. 18 (above). See text.
Fig. 19 (middle). See text.
Fig. 20 (below). See text.

PERICARDITIS

Pericardial adhesions and effusions give characteristic orthodiagraphic findings (Fig. 20). One may see a rounded or triangular shaped shadow when the effusions are great, or a localized modification of the form of the heart shadow, and a diminution and sometimes abolition of the visibility of the cardiac impulse. With a considerable increase in the size of the shadow, however, one generally finds that the horizontal and longitudinal diameters vary less than 2 centimeters. The pedicule is quite short and the heart borders seem to spread out abruptly right and left, giving a triangular appearance to the shadow. The cardiac impulse is barely perceptible in effusions.

The study of the vessels at the base of the heart is of even greater importance and will be discussed in a separate paper. Only the salient features and possibilities have been touched upon. A discussion of the conformation of the various physiological types of hearts has purposely been omitted. It is believed that this most valuable clinical aid should be more universally used by cardiologists in particular and clinicians in general in the diagnosis and prognosis of heart conditions.

BIBLIOGRAPHY

HODGES, PAUL C., and EYSTER, J. A. E.: New table for estimation of normal cardiac area. Am. Jour. Roentgenol. and Rad. Ther., September, 1924, p. 252.

HODGES, PAUL C.: A comparison of the teleoroentgenogram with the orthodiagram. Am. Jour. Roentgenol and Rad. Ther., May, 1924, p. 466.

KARSHNER, R. G., and KENNICOTT, R. H.: A practical method of roentgen examination of the heart. Am. Jour. Roentgenol. and Rad. Ther., May, 1922, p. 305.

KARSHNER, R. G.: X-ray of the heart. Southwestern Med., October, 1922, p. 362.

LEVI, IRWIN P.: The roentgen ray as an aid to diagnosis in cardiac lesions. Jour. Radiol., February, 1924, p. 41.

VAN ZWALUWENBURG, J. G., and WARREN, L. F.: The diagnostic value of the orthodiagram in heart disease. Archiv. Int. Med., February, 1911.

VAQUEZ and BORDET: Le Coeur et l'Aorte. J.-B. Bailliere et Fils, Paris, 1913.

WILSON, F. N., and MERRILL, E. F.: The value of the roentgen ray in cardiac diagnosis. Am. Jour. Med. Sci., March, 1923, p. 340.

Anemia after poisoning with radio-active substances.—In 1925, this author first reported the etiology, pathology, symptomatology and physico-chemistry of a series of cases of poisoning from ingestion of radio-active substances in the watch dial industry. The chief change was a leukopenic anemia sometimes associated with necrosis of the jaw. The symptoms were often deferred for a considerable time. Demonstration of the gamma rays from the body and in the expired air by means of the electrometer is reported. Autopsy showed radio-active substances of the alpha and gamma rays, particularly in the bones, spleen and liver. The minute particles underwent phagocytosis by the reticulo-endothelial cells and temporarily produced a seeming curative or stimulating effect, followed by exhaustion and destruction of the blood-forming centers.

Since then, another case has been studied in more detail, with special reference to the type of anemia and the distribution in the tissues of the radio-active substance. For seven years, the patient moistened her brush with her lips; she developed a chronic anemia, with necrosis of the jaw.

The blood picture showed a profound anemia, high color index, large cell anisocytosis, slight polychromatophilia, with an occasional basophile. The red cells showed an occasional megaloblast, with a few nucleated reds. The platelets were abundant. Autopsy showed the bone marrow to be abnormal—dark red throughout; microscopic examination showed regeneration of the megaloblastic type. After incineration, the electrometric examination showed that the bones stored most of the radio-active substance, although small amounts were found in the liver and spleen. Least was found in the gastro-intestinal tract, although this was the point of entry. This study emphasizes the importance of the storage in the reticulo-endothelial system.

TRESSA R. MORAN, M.D.

Microscopic Changes of Certain Anemias Due to Radio-activity. Harrison S. Martland. Arch. Pathol., October, 1926, p. 465.

RADIO-ACTIVE SUBSTANCES: THEIR THERAPEUTIC USES AND APPLICATIONS

THE APPLICATION OF RADIUM TO LARYNGEAL CANCER

By JOSEPH MUIR, M.D., New York City

ANYONE who undertakes a perusal of the literature on cancer of the larynx, or endeavors to evaluate the various methods of treating this disease which have been put forward during recent years, will find much to puzzle and confuse him. While many authors state positively that laryngeal cancer is one of the most intractable of neoplasms, early death being inevitable in all untreated cases and recurrence the rule after treatment of any kind, we find others regarding the whole subject in the most optimistic light, even going so far as to declare that "we may safely say to-day that intrinsic carcinoma of the larynx is the most curable of malignant diseases."

As is often the case when authorities disagree, the truth probably lies midway between these two extreme positions, and as data accumulate regarding this comparatively rare neoplasm, we may arrive at a juster estimate of the actual condition of affairs. It is to be hoped, also, that the advance in our knowledge of how to combat the disease may tend to swing the balance away from the side of pessimism, so that, eventually, the statement just quoted may find its justification.

The anatomical structure and the location of the larynx make malignancy in this part of the body difficult to control by any means of treatment. Operation is always somewhat hazardous and even under the best conditions results in loss of the speaking voice and a considerable degree of disfigurement, while the earlier methods of applying radium proved very unsatisfactory because of its disastrous effect upon the surrounding cartilaginous structures, even when the lesion itself was wholly obliterated. And with either therapy recurrence has continued to be distressingly frequent.

In considering any method of treating carcinoma of the larynx it is necessary to differentiate very sharply between the *intrinsic* and *extrinsic* type of lesion. So long as the growth has not extended beyond the laryngeal "box," the chance of cure by any agency is fairly good, granted that the condition of the patient in other respects is not unfavorable. But once infiltration beyond the larynx proper has taken place, the prognosis becomes very grave, and it is only in exceptional cases that life can be prolonged to any great extent, no matter what means are adopted for combating the disease.

However, in one respect the anatomical location has a distinct advantage. Because of its early interference with phonation, and the reflex coughing and other disturbing manifestations which it induces, the patient is likely to seek medical aid very early, so that a cancer seated in the larynx often comes under observation in its initial stages. Thus the surgeon or radiotherapist may have a fair opportunity to apply curative measures which may still be in time to be of some use, with correspondingly satisfactory results.

Because of the very general dissatisfaction felt with the results following surgery of laryngeal carcinoma, radium was early applied to this neoplasm, so that by 1920 Sonnenschein was able to collect from the literature 104 cases where radium had been employed. Of these, however, but eight were apparently cured, 14 being reported as "improved," leaving 82 upon whom radium either had had no beneficial effect, or—which was much more likely—had proved distinctly harmful. In 1921 we find T. J. Harris of New York stating that "there is general agreement among those who are working with radium that it has demon-

strated its great value in cancers of the larynx by relieving pain," but that "up to date, it cannot be claimed that there is sufficient warrant for the substitution of radium where surgery is indicated."

At the time these remarks were made, radium was being introduced into the larynx in tubes or capsules, or was being applied externally by means of plaques. Usually a single tube was held in place by hooks attached to wires, necessitating immobilization of the patient, and attended by many practical difficulties. A slight improvement was effected by the radium therapists of the Memorial Hospital (New York), who enclosed several three-millimeter platinum capsules in a piece of small rubber tubing which could be so placed in the larynx as to bring the carcinomatous area directly in contact with these centers of radio-activity, thus somewhat increasing the accuracy of the dosage. A little later, at this same institution, radium emanation tubes were introduced directly into the growth. They also employed a small glass bulb, 6 to 8 mm. in diameter, containing a total of 500 to 600 millicuries of radium emanation, the whole mounted with paraffin in a protecting metal cone. This was held in place by a wire, and permitted exposure of the carcinomatous area to an intensive dose of unfiltered radiation, while the cone tended to prevent injury of surrounding normal tissues.

None of the procedures have given wholly satisfactory results. The reaction induced was always tremendous, and the danger from edema of the throat so great that preliminary tracheotomy had to be done as a routine. As Quick said at the time: "Treatment designed to eradicate the disease is attended with considerable discomfort for several weeks at least. The inflammatory reaction causes pain and may interfere with swallowing and breathing as a result of edema. In bulky extrinsic growths sloughing and hemorrhage must be reckoned with." Yet, for all this, he felt that "if there is a reasonable chance to produce a complete regression of the disease, it is then perfectly justifiable to push treatment to the limit and risk putting the patient through a strenuous period of discomfort. If, on the other hand, only palliative relief can be hoped for, then the patient's physical comfort demands first consideration throughout."

Every attempt was, of course, made to obviate these disadvantages and decrease the disastrous after-effects of radium application. In 1922 Pfahler reported on the use of radium needles inserted through the thyrohyoid membrane. This method demanded a preliminary tracheotomy and X-ray exposures were also given previous to the insertion of the needles, the idea being "partially to devitalize the primary cancer cells and any metastatic lymph nodes which may be present," as this was thought to make puncture of the neoplasm less dangerous. "The larynx was crowded as far as possible toward the affected side, and the needles then introduced vertically, as near the center of the malignant area as possible." Ten-milligram needles were inserted about 1 cm. apart left in place for from four to six hours. If the growth had not disappeared after the lapse of three or four weeks, another set of needles was inserted. The reaction following these applications was very marked, but the presence of the previously inserted tracheotomy tube made it possible for the patient to breathe and swallow despite the great degree of edema.

The superiority of "bare tubes" over needles, even though these afforded at least a partial filtration, was, however, still maintained by the advocates of the implantation method. "Apart from the problem of beta radiation obtained," says Quick, "these emanation tubes for laryngeal work have a very definite advantage over needles containing radium salt, in that they are smaller, cause less trauma, and cannot be dislodged as a needle with a string at the end might.

In addition, the whole procedure is over at one sitting, and there is nothing left to be removed later. The glass emanation tubes . . . are either expelled and expectorated with minute particles of slough later on, or are encysted in scar tissue as a result of the inflammatory process created by the radium." The drawbacks to the implantation method were pointed out by Salinger, as follows: "First, the operation must be done by the direct route with any of the well known spatulas or the suspension apparatus. This is frequently made difficult by infiltration of the epiglottis and supraglottic structures. Second, there is danger in such cases of inciting the growth through undue trauma in the efforts to gain adequate exposure of the parts. Third, there is danger of sloughing out one or more of the tubes, with a resulting inhalation pneumonia or lung abscess."

That the method also had advantages he was, however, equally willing to admit, and he mentions the necessity of but one sitting, the diminished danger of injury to surrounding tissues, and the more adequate protection of the opposite unaffected side of the larynx.

Other operators continued to employ external applications, from which they reported satisfactory results. Newcomet, in treating a patient referred by Chevalier Jackson, used a 50-mg. capsule, filtered by 1 mm. of lead and 1 cm. of wood, which was placed in eleven positions upon the outside of the neck during periods of two hours, a total of twenty-two hours in all. Five similar sessions took place, the entire treatment occupying nearly a year. Yet he reports that this patient did not suffer the slightest inconvenience while under treatment; "there was a slight dryness of the throat which usually came on a few days after a treatment and lasted a week or ten days."

Yet it was only shortly after Newcomet made this optimistic report that the Cleveland Clinic went on record as saying that the value of radium in carcinoma of the larynx is limited to post-operative use in extrinsic growths and for palliation in inoperable cases. Still more recently, Salinger, the co-worker of Otto T. Freer of Chicago, a pioneer in the application of radium to the larynx, admitted that their experience "has been disappointing," in spite of the brilliant promise which their first laryngeal use of radium had given. It is the feeling of this writer that these results were not due so much to inadequacy of the agent as to "insufficient knowledge in its application." Another reversed opinion was that of Pancoast, who testified that "after adequate trial over a period of many years, we have found that the results of radiation in treatment of laryngeal carcinoma are very disappointing. We freely acknowledge the superiority of improved surgical technic in operable cases." He would at present relegate radium to the position of a palliative measure combined with tracheotomy in inoperable cases, and, under some conditions, for post-operative use.

In fact, most operators found the sequelæ of radium application to the larynx to be so distressing to the patient, and the final results so far from adequate, that the words of Harmon Smith, of New York, would seem to be justified when he said, "Radium is still in its uncertain stage, although occasionally very favorable results follow its use." And the final note of pessimism was sounded when Imperatori, a few months ago, after experience with more than fifty cases, concluded that "the cure of cancer of the throat, in all but exceptional cases, would not seem to be attained through the use of radium."

When we come to make a detailed analysis of the causes of failure in the application of radium to the larynx, two factors stand out with particular prominence: the tremendous reaction which has inevitably followed doses of sufficient strength to be

clinically efficient, and the great number of patients who were dismissed as apparently cured, only to return in a few months with rapidly fatal recurrence. It is, of course, to be expected that surgeons—and in particular those who have attained great technical skill in operating upon the throat, perhaps the most delicate intervention of its kind in the entire realm of surgery—should be opposed to the application of radium to those malignant lesions which are still confined to the vocal cords and the inter-arytenoid and subglottic areas, that is, entirely within the laryngeal "box." The excision of such a growth offers a good chance of total eradication, and the patient can be offered a most hopeful prognosis.

Yet the final condition of the patient operated on for anything but the very earliest type of laryngeal cancer is certainly not an enviable one. Deprived of his speaking voice, and doomed to wear a tracheotomy tube for the remainder of his days, even when it is possible for him in the end to resume relatively normal alimentation, he must first undergo a long and tedious convalescence which saps his physical strength and is bound to weaken the *morale* of all but the most optimistic. And when we consider that the majority of these cases occur in the sixth and seventh decades of life, the ambition of these patients to prolong the relatively few years normally remaining to them under such adverse conditions can certainly not be very great.

Radium has undoubtedly been proved capable of doing away with many of the drawbacks inseparable from surgery in the treatment of carcinoma of the larynx; that it has cured many cases where surgery was wholly impotent is also an established fact. The problem still remaining is to avoid reaction in the delicate normal tissues which surround the carcinomatous area, yet at the same time to administer sufficient radium dosage to render every carcinomatous cell absolutely incapable of mitosis, thereby doing away with all possibility of recurrence. Several years ago those radium therapists who had seen the greatest number of laryngeal cases realized that repeated dosage, here even more than in neoplasms elsewhere in the body, was an error, and probably accounted to a considerable degree for the failures in treatment. This was because the normal tissues, which were perhaps not seriously affected at the first irradiation, were rendered progressively more radioresistent at each succeeding exposure, while the mitotic cells, on the other hand, which were to all appearances permanently sterilized, were actually only halted in their activities, and by repeated exposures gradually became wonted to the effects of the rays, so that after a resting period of more or less duration they again became active, with resulting recurrence. As Pancoast has put it: "The difficulty lies in our inability to radiate properly the entire involved area, and we are prevented from giving an excessive dose such as might be given elsewhere because of the anatomical characteristics of the laryngeal structures. Subsequent operation in several primarily successful instances has shown an extensive lesion below the cords, part of which was no doubt beyond the range of vision and adequate radiation. The undestroyed portion below the cords has undoubtedly been the most frequent starting point of recurrence. If our internal radiation dose is too large we are apt to produce a perichondritis and more or less permanent injury to the cartilages, thus not only tending to break down a natural barrier against the spread of the carcinoma, but also making a more favorable field for its spread."

It is now possible to avoid injury to the surrounding structures and to prevent sloughing of the carcinomatous tissue by the use of radon seeds screened with platinum. These can be implanted either intratracheally, or inserted between the cartilages in a manner similar to that used by Pfahler

with needles. The completely screened seed, however, has many points of superiority over the needle, which always produces more or less necrosis, and can never be properly immobilized. Since these seeds are removable, the objection made to implantation, that it necessitates leaving foreign bodies in the tissues, is obviated, and there is no longer any danger of the seeds working out and being aspirated into the lung, an accident which has frequently been cited as a contra-indication to the use of radium in the throat.

The suspension method has been proved to give the most satisfactory exposure for the implantation of removable platinum seeds. In cases recently treated at the Postgraduate Hospital, New York, by Frank R. Herriman, seven such seeds were easily placed, using the suspension method, and the results so far have greatly exceeded any heretofore obtained from the use of radium in any form. All of these cases were so far advanced as to be considered inoperable. In most of the cases the malignant mass was found to have regressed completely fifteen days after the seeds were implanted. All these implantations have been done too recently to permit our making any sweeping generalizations, but in no case have there been any untoward symptoms, and notwithstanding the fact that tracheotomy was done in some instances, for fear of a marked reaction, there has been practically no edema of the throat, or other difficulties. When one compares the condition of these patients with that of those who have undergone operation, the advantages of radium treatment are obvious. The patients can speak aloud and are able to swallow without difficulty, and have not had to undergo any tedious and discouraging convalescence before they were able to return to their normal mode of living. It seems possible that in the implantation of removable platinum seeds a means has been found of giving radium the advantage over surgery, not only for those cases now rated as inoperable, but also in the more favorable lesions which are still considered by the surgeon as peculiarly within his province.

REFERENCES

CRILE, G. W., and DINSMORE, R.: Carcinoma of the larynx. Surg. Clin. N. A., August, 1924, IV, 845.

FRASER, J. S., and WATSON, D.: Notes on fourteen cases of intrinsic cancer of the larynx. Jour. Laryngol. and Otol., February, 1924, XXXIX, 79.

HARRIS, T. J.: Radium in cancer of the larynx, with particular reference to dosage and the dangers of its employment. Laryngoscope, 1921, XXXI, 872.

IMPERATORI, C. J.: Carcinoma of the larynx and laryngopharynx treated with radium. Arch. Otolaryngol., August, 1926, IV, 151.

JACKSON, CHEVALIER: Cancer of the larynx: is it preceded by recognizable pre-cancerous signs? Ann. Surg., January, 1923, LXXI, 1-14.

LEWIS, F. O.: Laryngeal cancer: its treatment, with special reference to total laryngectomy. Laryngoscope, August, 1925, XXXV, 607.

NEWCOMET, W. S.: Radium in cancer of the larynx. Surg. Clin. N. A., February, 1924, IV, 97.

PANCOAST, H. K.: Some observations on the radiation treatment of carcinoma of the larynx. Am. Jour. Roentgenol. and Rad. Ther., September, 1924, XII, 217.

PFAHLER, G. E.: Radiotherapy in carcinoma of the larynx. Jour. Radiol., December, 1922, III, 511.

SALINGER, S.: Radium emanation in carcinoma of the larynx. Arch. Otolaryngol., March, 1925, I, 286.

SMITH, HARMON: Intrinsic cancer of the larynx. Laryngoscope, March, 1924, XXXIV, 214.

SONNENSCHEIN, ROBERT: Radium in the treatment of malignant tumors of the nose and throat. Jour. Am. Med. Assn., September 25, 1920, LXXV, 860.

TREATMENT OF CARCINOMA OF THE BREAST

By ROBERT E. FRICKE, M.D., Howard A. Kelly Hospital, Baltimore, Md.

IN THE Fall of 1925 two patients with cancer of the breast were referred to me by Dr. A. B. Glascock, of Baltimore. The difference in response to radiation therapy and in the progress of the disease in the two cases presents certain points of interest.

Case 1. Mrs. J. R. R., aged 70, was admitted September 28, 1925, with a deeply ulcerated growth of the right breast, the whole mass measuring 9 x 14 cms. (Fig. 1). The growth was bathed in a very foul discharge. There were several skin implants near the main lesion.

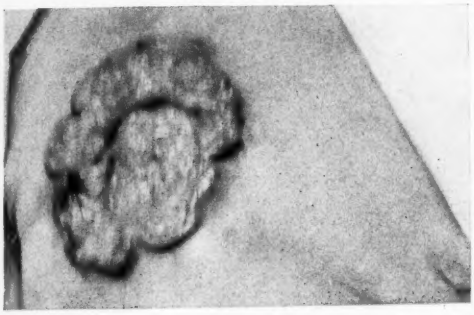


Fig. 1. Case 1, showing condition upon admission, before treatment was instituted.

The growth had commenced three years previously. For the past two years electrical treatments (nature unknown) had been given by a doctor in New York City, without effect on the lesion.

No metastatic glands were detected. Tissue examination showed adenocarcinoma. The Wassermann was negative and the X-ray of the chest was clear.

The patient had lost 26 pounds in the last two and a half years; her weight was now 92 pounds. The prognosis in this case was very bad. We hoped for palliation over a few months.

Case 2. Mrs. D. L., aged 59, came in November 20, 1925, with a small projecting lump at the lower inner quadrant of the right breast, 4 x 4 cms. in diameter, adherent to the skin and the underlying tissues. A small area of ulceration was present at the lower pole of the tumor.

The condition had commenced as a very small lump three years before, with gradual steady increase in size, and ulceration two and a half months previous to admission. No treatment had been given.

Fig. 2. Case 2, showing diffuse spotty infiltration of both lungs.

There were palpable glands in the right axilla. Biopsy showed adenocarcinoma. The blood Wassermann was negative. A chest plate revealed diffuse spotty infiltration of both lungs, especially the lower lobes (Fig. 2).

The prognosis here was grave, but the general condition of the patient was far better than that of Case 1, and the local disease not nearly so advanced.

The response to radiation therapy in Case 1 was most gratifying. Heavy implantation of spicules of radium emanation, with external application of radium, quickly reduced the growth and stopped the offensive discharge. In June, 1926, a gland which may have been metastatic was felt above the right clavicle. This was reduced

by treatment with the deep X-ray. Radium treatment has been applied from time to time as indicated and the regression of the growth has been remarkable; at present (October, 1926) there is only a shallow

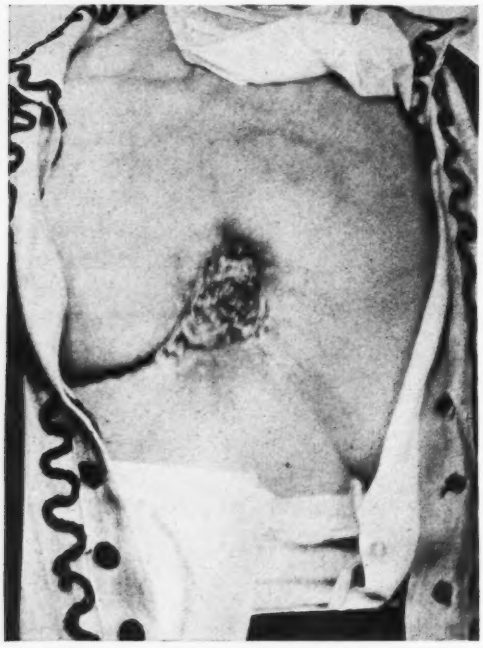


Fig. 3. Case 1, showing condition in September, 1926; only a shallow healing ulcer remains and the patient's general health is excellent.

healing ulcer measuring 4 x 5 cms., and her general health is excellent (Fig. 3). There is now a good prospect of permanent cure.

The progress in Case 2 was disappointing Massive radiation with radium packs to the breast growth and deep X-ray to the axillary glands produced some slight regression, but her general health declined and by January, 1926, she was confined to bed. She was taken to a local hospital for nursing care. Here in February, 1926, the cancer was removed under local anesthesia with the endotherm knife. The patient was discharged March 5, 1926, with the operative wound nearly healed; she grew steadily more cachectic and died March 17, 1926.

SUMMARY

Two patients with cancer of the right breast of identical nature microscopically and with a history of the same duration of the growth were treated energetically with radium and X-ray. The first case had by far the more extensive local lesion, apparently hopelessly advanced, and her general health was poor. She has responded splendidly to the treatment and is in good health to-day. Case 2, with a small local growth but apparent early rapid extension to the lungs, failed rapidly, with little benefit from radium and X-ray and surgical ablation of the lesion, and died four months after inception of treatment.

No conclusions can be drawn from two cases, but the difference in response to radiation is interesting. The obvious importance of a chest plate in every case of cancer of the breast is emphasized, as is the utility of energetic treatment of even massive and apparently hopeless malignancies. It is the occasional unexpected splendid result in these huge malignant tumors which encourages one to conscientious effort in every case, no matter how discouraging the outlook may be; expecting only slight palliation, we are often able to effect a cure.

EFFECTS OF FOOD IRRADIATED WITH X-RAYS UPON MICE

By JOSEPH K. NARAT, M.D., CHICAGO, ILLINOIS

IN the first era of radiotherapy the theory prevailed that the action of X-rays was confined to the irradiated area; in other words, it was regarded as a local process. Gradually, observations accumulated which furnished positive proof that X-rays also exert a general action upon the irradiated individual, particularly upon his blood. Only few facts may be cited. The hemoglobin and blood sugar show certain quantitative changes after irradiation. The sedimentation time of the red blood corpuscles is prolonged. The leukocytes are affected and destroyed. Often the blood pressure is lowered. The quantity of sodium chloride in blood serums is diminished. The acidosis of blood serum after irradiation soon subsides and gives place to alkalosis; the amount of creatinin and fat in serum increases; coagulation time of blood is shortened; increased diuresis is produced; more sodium chloride is excreted by the kidneys; the metabolism is lowered.

The activity of invisible rays is not limited to living tissues. Experiments of Steenbock and Black (1) and at the same time those of Hess (2), have demonstrated that the exposure of some foods to ultra-violet radiation endows those substances with antirachitic properties, not previously possessed by them. Thus the power of cod liver oil to prevent rickets can be given to almond or olive oil by irradiation with ultra-violet rays, emitted by a mercury vapor lamp. Other vegetable oils and leafy vegetables may be influenced in a similar manner. Only recently has the significance of the invisible radiations for the welfare of human beings begun to be appreciated. The striking experience with regard to the effect of ultra-violet rays has led to further investigations of the action of invisible rays.

Ludwig and Hopf (3) undertook a series of experiments to study the properties of food irradiated with X-rays. Bread and carrots were exposed to the action of roentgen rays and then were used as food for young white rats. Shortly after the experiments were started the rats ceased to increase in weight. Very soon a rapid loss of weight could be noticed in every animal, followed by death fifteen to thirty days later. At the end of the twelfth week from the beginning of the experiments, every rat was dead; forty-seven out of fifty control animals were still alive. A diminished appetite, toilsome movements, and tenderness of bones to pressure could be observed in animals fed with irradiated food. The autopsies revealed a fatty degeneration of myocardium and liver, hyperemia of spleen, and signs of rickets in the bones. In regard to the technic of irradiations the authors do not make exact statements. They merely mention that hard rays, 220 K.W., and a filter of 1 mm. aluminum were used.

In view of the great importance of these findings and our limited knowledge of the mode of action of the invisible radiations, it was decided to study the influence of irradiated food upon mice.

One hundred and twenty mice of the same stock and approximately the same age were selected for these experiments. Eighty were fed with irradiated food; forty were control animals. The mice were kept in cages made of wire netting, each cage containing ten mice. All cages were placed in the same room with a good exposure to sunlight; they were bedded with sawdust and cotton. Fresh water, not irradiated, was given daily. The animals were weighed every week. The food consisted of a mixture of white oats, cracked corn, hemp, and buckwheat; twice

weekly, birdseeds were added and on two other days boiled potatoes supplemented the regular diet; bones were kept constantly in every cage. The food was weighed daily and exactly the same amount placed in each cage immediately after the daily irradiation, performed as follows: 5 milliamperes, 120 kilovolts, 1 millimeter aluminum filter, 40 centimeters distance, 20 minutes. The food was spread over a plate to form a layer one centimeter thick.

The experiments lasted four months. The first noticeable effect from the irradiated food was gradual loss of activity of the animals. About ten days after starting the experiments the motions of the mice became gradually less lively and vivacious. While the control animals were climbing the sides of their cages, the mice fed with irradiated food moved chiefly on the bottom of the cages. About one month from the date of the beginning of the experiments, fifty-three mice out of eighty began showing retardation of growth. The results are shown in the following chart (Fig. 1).

Reference to the chart shows that variations of the curves were not very considerable. The chart represents the average weight of all eighty mice fed with irradiated food. As mentioned before, twenty-seven mice out of eighty did not show any noticeable retardation of growth. This fact explains why the curves are so close to each other. However, the weight of some mice was very small as compared with the normal. For instance, one mouse weighed 19 gm., while the lowest weight among the control mice was 43 gm., but not more than ten mice were so extremely small. Eleven mice not only showed retardation of growth but started losing weight at a definite time. All these mice died from various diseases. At the end of four months eighteen deaths were recorded among the eighty mice, while only two deaths occurred among the forty control animals.

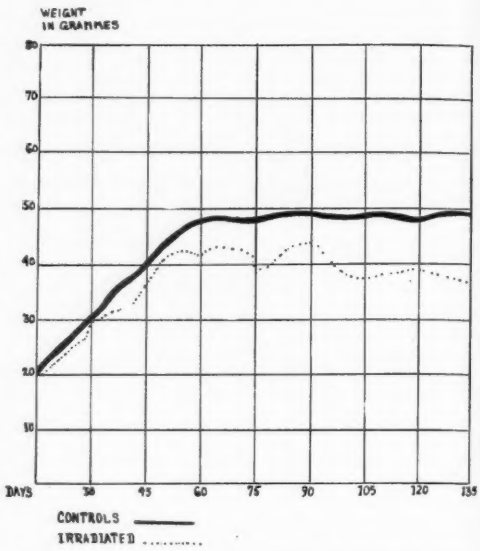


Fig. 1. Curve resulting from four months' feeding of irradiated food to eighty mice and non-irradiated food to forty control mice.

A careful microscopic examination failed to reveal any specific action of irradiated food; particularly, no signs of rickets could be noticed. The fact deserves to be mentioned that two cases of pregnancies ended without any complications and that the litters were apparently healthy.

DISCUSSION

The experiments only partially confirm the results of Ludwig and Hopf regarding the growth-retarding or inhibiting effects of irradiated food. Some of the animals grew as well as the control mice. The experiments may be varied in regard to quality and quantity of X-rays, the length of exposure, the interval between irradiation and feedings, the kind of food, etc., but our experiments point to the conclusion that we are not justified in making an assumption that irradiation of food with X-rays may cause rickets.

CONCLUSIONS

There is a direct action of X-rays upon food.

Feeding of mice with food exposed to X-rays causes—

1. Diminished activity of the animals and sluggish motions;
2. Retardation of growth in about one-third of the cases;
3. Loss of weight in few instances;
4. Increased morbidity and mortality;
5. No signs of rickets;
6. No interference with pregnancies.

Further experiments must be made to determine whether X-rays destroy substances of vital importance in food or transform them into toxic material.

REFERENCES

1. STEENBOCK and BLACK: Jour. Biol. Chem., 1924, LXII, 209.
2. HESS, A. F.: Jour. Biol. Chem., 1924, LXII, 301.
3. LUDWIG and HOPF: Strahlentherapie, 1925, XX, 342.

THE ELECTRON IN AND OUT OF THE ROENTGEN TUBE AND THE RADIUM ATOM[1]

ITS BIOPHYSIC AND BIOLOGIC ACTION IN THE TREATMENT OF CERTAIN PATHOLOGIC PROCESSES

By DONALD C. A. BUTTS, F.A.I.C., F. C. BENSON, JR., M.A., M.D., F.A.C.S., and J. W. FRANK, M.D.

From the Emery Laboratory of Experimental Radiology and Roentgenology, Hahnemann Medical College and Hospital, PHILADELPHIA, PA.

THOSE who have studied the structure of the atom, and those familiar with the results obtained by such twentieth century scientists as Rutherford, Millikan, Bohr and Thomson, know that the atom is composed of two distinct parts or segregations of particles: the central nucleus, composed of protons and electrons, and other electrons comprising the planetary system.

These component parts, although naturally in very close proximity, are nevertheless distinctly separated. The peripheral electrons move about in restricted limits or orbits and are separated from the nucleus and from one another by the same medium as that surrounding our great universe, the "ether of space."

The protons, regardless of the atoms of which they form a part, consist of definitely charged positive particles, while the electrons, whether planetary or within the nucleus, are definitely charged with negative electricity.

In the study of chemistry, organic or inorganic, we must consider the structure of the molecules of known elements, and how such molecules arrange themselves when forming definite chemical combinations, or how they dissociate when such compounds are broken down, under one influence or another, to form new and entirely different compounds. When we consider the reactivity of two or more elements or compounds with one another, we are indeed considering the stability of atoms entering into the formation of these elements and compounds. All this information is of great importance to the chemist, and it is through this knowledge that the science of chemistry has made such tremendous strides within the past few years. It is upon this knowledge that accomplishments, once viewed as fantastic dreams of the alchemist, are now being materialized.

We, who are dealing with the subjects of roentgenology and radiology, and indeed the medical profession as a unit, must realize that *all* chemical combinations and reactions, whether carried out within the test tube or within the body cell, are dependent upon the combinations and recombinations of such molecules; but we must not stop here, for the molecule is but an intermediate unit between the resultant chemical combination and the basis of its structure, *the atoms.*

We must further realize that every function of the body, whether an act of secretion, a nerve impulse, a muscular contraction, the processes of respiration and pulsation, the divisions of the cells—beginning with the fertilization of the ovum and continuing until the last contraction of the heart muscles, the last respiration takes place—is nothing more or less than a series of well regulated chemical reactions. Indeed, life itself is nothing but an elaborate chemical organization governed, as are all chemical reactions, by the action and interaction of the molecules comprising the agents involved; and still more basic, of the atoms, segregated, classified and balanced to form the molecules.

From this reasoning we are forced to reduce the process of life to one of atomic and intra-atomic energy, a purely physical foun-

[1]Submitted for publication February 15, 1926.

dation, dealing with the discontinuous units of which matter is composed, *i.e.*, protons and electrons; with positive and negative ions, electro-magnetism, electric and thermic conductivity. Its basis is simple, its mechanism complex and evasive.

On the other hand, when coping with the various abnormalities which originate within the body organs and tissues, and which are classified as one disease or another, we are dealing with nothing more nor less than disturbed chemical or, still more basic, physical balance of the cells which comprise the organ or part involved.

Do we need any further evidence to establish the possibility that all pathologic change is, first, physical; second, chemical, and lastly—or as viewed by the pathologist —histological?

During the process of repair the mechanism just outlined follows somewhat of a similar action, *i.e.*, when using rays and radiations from the roentgen tube or the radio-active agents the change (biologic) is first of physical nature; this brings about a more or less repaired chemical balance and alteration which later leads to modified histological arrangements and adjustments of the structures involved. However, it is not until the physical construction is definitely and permanently balanced that we can consider this repair and restoration complete.

From a theoretical aspect this working basis remains constant, and experimental results tend to confirm these hypothetical deductions.

From this concept it can be reasoned and demonstrated that if alterations follow in the sequence mentioned, reversed physical measures must be employed to bring about the ensuing alterations of the processes of repair. This becomes fundamental in the study and usage of agents whose initial action can be none other than the powers confined to their structure, *i.e.*, physical, followed immediately by biophysical manifestation.

For a considerable time roentgenologists and radiologists have claimed that the desired action of their respective physical agents was one of destruction, and have put forth every effort to intensify dosage in order to accomplish this result.

Plant and animal experimentation demonstrates that the rays from radium and the roentgen tube possess, in modified quantities, still another action,—that of modification and arrest of cell growth.

Dauphin (1904) demonstrated that when small quantities of radium were kept near cultures of mortierella for several days, a zone of growth inhibition appeared where the ray action was most intense. Upon removal of the radium, and the replacement of the spores to normal conditions, they flourished again.

Koernicke showed that if the roots of beans and turnips were exposed to the beta and gamma rays from small quantities of radium for two or three days, their growth was checked, and then side roots or shoots gradually began to form.

Emulsions of Jensen's rat sarcoma exposed to 0.275 millicurie of radium emanation (beta radiation) for thirty minutes, upon inoculation into animals, formed tumors, but very slowly (about one-third of normal rate), and by successive grafts from this slowly growing tumor for more than a year, the tumor was found to be growing at about one-third of the normal rate.[2]

In such experiments it is quite obvious that the dosages employed were not of sufficient intensity to result in a destructive action upon the irradiated cells, and we are forced to recognize an underlying biophysical or physico-chemical action brought about within the cell body, whereby its normal metabolism or "habit chemistry" took on new properties and characteristics. The above mentioned experiments constitute but

---

[2]It is the hope of the writers that biologic experimentation now under way in this laboratory may serve to extend our knowledge of the action of selected rays on plant and animal life.

a very small percentage of those conducted, supporting such a contention.

In the preparation of this report the writers have attempted to reduce the problems of roentgen—and radium—therapy to their basic significance. In order to demonstrate their scientific worth in the treatment of malignancy we shall make an effort to place the subject of oncology on a like basis.

Those who have been engaged in cancer research know that for a theory of etiology to be sound it must likewise explain the phenomenal difference between embryonal and adult tissue, and its application must cover forms of neoplasms other than carcinoma. All who have studied pathology know that the more embryonal the characteristics of the neoplasm the more malignant its nature.

From this knowledge we are forced to recognize the striking similarity between the rapid, but governed, reproduction encountered in the development of the embryo, and the less rapid, but ungoverned, proliferation existing in the formation of malignant tumors.

The recognition of the similarity between the two forms of tissue above mentioned is by no means credited to the writers, but the explanation for the underlying cause and effect displayed in the two forms lays the foundation upon which we have constructed a scientific, safe and effective means of radium — and roentgen — therapy, to control the ravaging processes of the unrestricted cell division of malignancy.

This study has occupied the time and earnest efforts of the writers in both the experimental and clinical fields, and has yielded results superior to any method of physical therapy heretofore employed.

Let us first consider the underlying factors possibly responsible for the fertilization of the ovum and the resultant formation of the embryo. Two agents alone enter into the process of fertilization and cytogenesis, the ovum and the spermatozoon. These two minute organisms, composed of nothing more nor less than aggregates of chemical molecules and—still more basic—physical (or chemical) atoms, when united, react with such vigor that within the allotted time a body, living and functioning, is formed.

If, however, stimulation is supplied to the ovum *other* than that offered by the entrance of the sperm head, the cell is forced to undergo division and, in so doing, develops its possessed but limited components of life, but lacking those essentials transmitted by the spermatozoon. As the result of this *abnormal* stimulus a mass, possessing some of the features confined within the ovum, is developed and manifests itself in what we know as an ovarian dermoid.

It is beyond the realm of man to explain the etiology of life, and let it here be made clear that the writers make no attempt to disclose its solution. However, if we can offer some facts determined as to the chemical and physical nature of the two basic constituents from which life is derived, we are justified in claiming a theory of etiology for neoplastic conditions; for both processes are accompanied by greatly stimulated cell reproduction—*they are both functions of the living cell.*

The theory about to be presented has been substantiated again and again by carefully controlled experimentation, deductive reasoning, and findings of other investigators. It is upon this theory, and the resultant research, that the writers have altered X-ray —and radium—therapy to obtain results of most gratifying nature.

Brief consideration of the physico-chemical composition of the ova and spermatozoa will illustrate the point under consideration.

It is indeed true that a work of considerable length might be devoted to the subjects of fertilization and cytogenesis without more consequence than casting suspicion as to the facts regarding life. The few points advanced in this report are intended solely for the purpose of introduction to the

explanation underlying the theory of neoplastic etiology and development herewith advanced.

All cells, to the knowledge of the present-day biologist, consist of two major portions, nucleus and protoplasm, each possessing its essential properties and characteristics for cell life. To best understand the physical alterations which occur, stimulating the process of mitosis, we will resort to a fundamental and recognized example.

Ova, like other cells, consist of a nucleus and protoplasm, each of these component parts meeting the chemical—and therefore the physical—requirements of other cells. This remark forces an explanation of the physical and chemical properties of nuclear and protoplasmic elements, and accordingly brings us to an outstanding point in the development of neoplasms.

For a detailed study of the cell nucleus the sperm head offers the most suitable material, for it consists almost entirely of nuclear matter. It must be remembered that it is the head alone which enters into the process of fertilization and cytogenesis, the tail merely affording a means of propulsion. After a series of suspensions, centrifugations, and separations, the heads are freed from the tails and offer pure nuclear matter for analysis. The material so obtained is found to consist almost entirely of chromatin (apparently the most radiosensitive portion of the cell). The chromatin, upon examination, is found to be composed of two parts: one, an acid portion (nucleic acid); the other, a basic part (some member of the simple proteins).

A more basic analysis of these two constituents of cell nuclei demonstrates that the nucleic acid is *electro-negative*, while the basic portion (protamines or histones) *is strongly electro-positive, even in faintly alkaline solutions*. Regarding the other major portion of the cell, the protoplasm, a few remarks will suffice our purpose.

Protoplasm consists of approximately 70 to 93 per cent of water, the whole structure of this portion of the cell being of colloidal nature. All protoplasm contains an aqueous solution of common salts, and, as we know, the outstanding property of salt solutions is their ability to conduct the electric current. When the electric current is passed through protoplasm, accumulation of positive particles takes place around the cathode, while the negative portions seek the anode. Since only electrically charged particles move with or against the current, the colloidal particles forming the protoplasm must be charged.

The points just formulated demonstrate that the protoplasm, like the nucleus, is composed of electro-positive and negative particles, which, in the normal, resting cell, are delicately balanced so as to carry out its portion of the cell's duty.

As shown in a preceding paragraph, the medium through which these positive and negative particles or portions interchange is well planned for electro-chemic function of the cell, and the whole organism is a complete and powerful *electro-chemic unit*. Now that we have briefly considered the basic physical—or electrical—structure of the two agents responsible for fertilization and cytogenesis, we are better prepared to understand the nature of the initial stimulus supplied to the ovum, causing it to undergo rapid division. This point once clear, we are better able to cope with the problem of tumor development.

Let us here consider the ovum a physically balanced organism, the nucleus of which is electro-positive as compared with the protoplasm. Due to the presence of a nuclear wall, the integral parts of the ovum are kept distinctly separated, under ordinary conditions.

Under the natural form of stimulation the fertilization is complete, and in due time terminates in the formation and development of the embryo. The ovum, receiving its positive stimulation from a source other than that of the sperm head, takes on an-

other form of development, manifested as an ovarian dermoid, previously mentioned and considered.

In the case of epithelial or connective tissue elements we are justified in believing that through physical effects brought to bear as the result of chronic irritation, oxidation processes,[3] or perhaps more remote sources, a *positive* stimulus is supplied to the cellular elements involved, thereby disturbing the stored up energy contained within their atomic structures. *Where there is Matter there must be Energy.*

This working foundation being true, we would naturally suppose such abnormal structures to exist in an electro-positive state of physical unbalance. This being the case, it would naturally follow that metastases would be due to reproduction of cells, electro-positive in nature, disseminated from the original or primary focus to other parts of the body.

The occurrence of mixed forms of neoplasms could readily be accounted for by the consideration of the powerful stimulating properties and powers of unbalanced intracellular mechanism and energy.

Cohnheim's theory finds staunch support by this method of reasoning and were there ever a specific micro-organism found to be the causative factor in tumor formation, its evasive mode of action and stimulation could likewise be reduced to this basis; for all micro-organisms are composed principally of nuclear material and are therefore *electro-positive* in physical or electro-chemical construction.

However, this is enough of theory and we shall pass to the experimental or practical application, and how it has developed the method of X-ray—and radium—therapy employed by the writers.

Within the past two years one of the writers has conducted an extensive investigation of the physical properties of normal and neoplastic tissue and the effect of various spontaneous and generated radiations upon such structures. The results obtained from this investigation have been reported previously.[4]

Due to the extensive space which would be occupied by a detailed description of these experiments, we will merely formulate the results obtained and the deductions made, in order to make clear all points advanced in this report.

Verifying theoretical deductions, it has been proved almost conclusively, by animal and physical experimentation, that *neoplastic tissue possesses a greater or higher potential than normal tissue,* most probably due to alterations causing the loss of electrons. Tissue so examined was found to be electro-positive as compared to normal tissues. This experimentation was conducted upon hundreds of living rats, bearing most of the recognized strains of experimental tumors, as well as animals afflicted with spontaneous tumors.[5] Embryonal tissue (living rat embryo) gave the same reaction as did the neoplastic tissue, but to a more marked degree.

Many of the recognized chemical alterations accompanying progressive malignancy are readily accounted for if we conceive the initial alteration as being of the physical nature advanced in this report. Among these we mention:

(*a*) Increase of unoxidized sulphur in the blood and urine.
(*b*) Increase of xanthine in the urine.
(*c*) Increase of urinary ammonia.
(*d*) Decrease of urea in the urine.
(*e*) Excess of lactic acid and the decrease or absence of free hydrochloric acid, accompanying advanced gastric malignancy.

---

[3]Oxidation or reduction processes are primarily of electro-chemical nature and are propagated by the electro-chemical nature of the agent responsible for the change.

[4]See references at end of this paper.

[5]The writers are now directing their efforts towards determining, by means of standard physical apparatus, the degree of potential alteration observed in human neoplasms, before and following irradiation.

The physical features of normal and abnormal cellular structures having been carefully studied, we hoped that similar methods of investigation might suggest the basic action of X-ray and radium therapy in malignancy. If destruction of cellular elements was the only therapeutic action of these agents, we might as well return to the cheap and effective agent—the soldering iron. But there was unquestionably a more remote action of radiations from the roentgen tube and radium upon the neoplastic cell, and this was what we hoped to find.

Physical analysis of radiations from these two separate and distinct sources demonstrates a marked analogy, their primary radiations being physically identical; in each case one form of electro-magnetic radiation and two forms of corpuscular rays, or particles, are liberated, differing only in origin and wave length. Gamma and X-rays are both electro-magnetic waves, devoid of any corpuscular structure; beta and secondary corpuscular rays, or particles, are negatively charged (electrons); while the alpha particles and canal-rays (*Canalstrahlen*) consist of positively charged particles.

A careful physical study of the available radiations (gamma and beta) upon living neoplastic tissues revealed the following data. (The alpha, or positive, rays can naturally be disregarded as having any therapeutic value, due to their extremely feeble penetration.) It was easily and satisfactorily demonstrated that the rays of electromagnetic nature, *i.e.*, gamma and X-rays, primarily exerted little, if any, effect upon the increased potential displayed by neoplastic tissue.

Tumors exposed to rays bearing a negative charge of electricity demonstrated an almost immediate response, manifested by a rapid reduction in potential, approaching that of normal tissue structures. This reduction in cellular potential to normal, once brought about and maintained by short repeated exposures to the secondary rays (electrons) from the roentgen tube or to beta radiation (electrons) emitted from the bare glass "seeds" of radium emanation (niton or radon), resulted in rapid atrophy of the tumor mass. *In all cases so treated the accumulative dose was far below that necessary to "kill" the cells comprising the neoplasm.*

There seemed to be but one conclusion to be drawn from these observations. We were impressed with the fact that the alteration was obviously a physical one; that in the use of either of these negatively charged agents electrons were supplied to the electron-deficient tissues, thereby restoring them to their normal physical or physico-chemical balance and "habit chemistry."

This information once obtained, we were confronted with the problems of determining the best means of electron-production, and ascertaining, if possible, the amount necessary to bring about—in cases so treated—the desired biologic cell change, *without destruction.*

The former of these problems was easily handled in the case of radium by employing its first disintegration product—radium emanation. This element (a gas), when sealed in capillary glass tubes, emits a preponderance of beta particles (electrons), following the formation of active deposit on the inner walls of the "seed." Gamma rays, to some extent, are formed and released from the "seed" following the formation of Ra.A, Ra.B and Ra.C, which are disintegration products from the emanation. Alpha particles are entirely restricted to the interior of the "seeds," the walls of which prohibit the passage of these particles into the tissues. Thus in the sealed capillary glass "seeds" of radon we were supplied with material for the experimentation about to be reported.

Sterile "seeds" of varying strengths (0.121—0.2437—0.4875—1.1025 millicurie, or, expressed in fractions, ⅛—¼—½—1 mc.) were placed into the ear, conjunctiva of upper lid, and bladder wall of healthy

rabbits, in an effort to determine at what strength destruction of normal tissues occurred and the area involved in the process. This experiment was controlled by placing into the localities mentioned, sterile "seeds" —(dead) lacking any power of radio-activity. These "seeds" were prepared by sealing off, without the addition of any of the gaseous element radon, capillary glass tubing of the same dimensions as those of the active "seeds." By this method of control any possibility of a destructive action as due to traumatism would be eliminated. The experiment was conducted under the same aseptic conditions as would be employed for similar work on humans.

For the bladder experiments a suprapubic cystotomy was performed and the "seeds" implanted directly in the bladder wall, a very delicate and tedious procedure. The reason for selecting the urinary bladder as the seat of implantation is obvious. We hoped to be able to combat efficiently any existing pathology without sufficient dosage to cause necrosis and sloughing, with the possible development of peritonitis and death. By this experimentation we further hoped to ascertain a safe dosage for all implantations of the element, radon. This once determined, our scope for internal local therapy would be unlimited in all accessible localities.

The deductions made from these experiments, together with the clinical results obtained by the application of the theory and experimental findings advanced in this report, were, in addition to those already mentioned, as follows:

First: That doses of 0.121 millicurie (⅛ mc.) of sealed "seeds" of radium emanation, per cubic centimeter of tissue, were sufficient to bring about the desired biological cell change within the neoplastic tissue.

Second: That doses exceeding 0.2437 millicurie (¼ mc.) per cubic centimeter of tissue, exhibited destructive effects, increasing in intensity with increasing dosage. This destructive action was manifested as a marked hyperemia, lasting for a period of about ten to twelve days, followed by progressive necrosis and sloughing.

Third: That doses below 0.25 mc. per cubic centimeter of tissue could be used with absolute safety for implantation of internal cavities.

Fourth: That with doses of 0.25 mc., or less, there was no accompanying rise in temperature due to radiation, therefore eliminating any danger of combining the result of implantation of radium emanation "seeds" with the initial temperature rise associated with post-operative conditions.

Fifth: That by this method of therapy we were permitted to introduce the "seeds" into pathologies in close proximity with the great blood vessels without any inherent danger of destruction to the vessel wall, *i.e.*, sloughing, with resulting hemorrhage.

Last, but not least: That by the employment of fractional doses of properly screened element, prophylaxis might be hoped for. By such technic the natural barriers to dissemination (the lymph glands) were reinforced rather than destroyed, thus offering far greater hopes in combating metastasis than in weakening the natural defences of the body by surgical removal or destruction of the lymph nodes. Such prophylactic treatments are given by the use of sufficient amount of element, properly screened, so as to produce a mild amount of secondary beta radiation throughout the depth. In this manner—knowing that the gamma rays are given off in all directions and during their passage through the tissues break up and give rise to electron formation —a wide field is suitably radiated. The implantation of emanation "seeds" would be inadequate for such purposes, but the use of secondary corpuscular rays from the roentgen tube, as shall be considered, is deemed advisable under the proper conditions of control.

It has, we feel, been conclusively demonstrated that any deviation in the body

physico-chemic or electro-chemic balance (cellular-molecular-atomic) is followed by abnormal conditions: first, physical; second, chemical; third, pathological: that a return to normal physico-chemical equilibrium will be followed by health — "a return to normalcy." We find this to be particularly true in the case of malignant neoplasms, as demonstrated by our clinical experiments in a large number of cases, including the more common forms of tumor growth, in various tissues and locations.

We have found that malignant tissue has increased potential, thus changed polarity; that it is *electro-positive,* and for correction depends upon sufficient—*and only sufficient* —negative electrons to restore it to physico-chemical balance. These are ably supplied by radium and roentgen therapy. *Correctly applied,* these agents will bring about diminution in size of constructive neoplasms and healing in those of destructive type. Thus is offered not only a sane and scientific theory of oncologic histogenesis, but, also, an occasion to place on a firmer foundation the science of radiology and to increase greatly its field of usefulness in the therapy of malignant pathologic processes.

It has been demonstrated that we can disregard the alpha particles, as they are not available in the therapy. We must, then, make use of the beta particles (or rays, so-called) and the gamma rays in radium therapy, and, as it has been shown that the gamma rays only cause biologic cell change by the incidence of secondary beta ray (electron) production, we must come to the conclusion that the beta ray is of paramount importance in the rôle played by radiology in the treatment of malignancy. Then, when we consider that the physical characteristic of the beta ray is its inherent power of carrying the negative electron, we arrive at the explanation of the curative value of the radio-active substances in oncology, as well as a clearer understanding of the theory of neoplastic etiology herein presented.

This brings us to a consideration of clinical application in this form of radiology and the results obtained.

Radium is used in the treatment of malignancy in one of two ways: first, as the elemental salt, in varying quantity, screened to prevent the escape of excessive beta radiation (which would, otherwise, cause gross tissue destruction) and depending for biologic change on very moderate original beta ray production and secondary beta ray incidence in the depth; and second, the emanation (radon), without screenage—except to alpha particles and very soft beta particles —giving off maximum original beta ray production and minimum gamma radiation. It can be very readily understood that in the case of the latter form of application the necessary beta ray (electron) production may be obtained by very fractional dosage, as compared with the former method; also, that the negative ray production from the emanation, being original, can affect only a limited amount of tissue, as compared with the secondary beta ray production of the gamma beam (which may reach any depth). Thus we see that both methods have their individual advantages. It must also be remembered that the radio-activity of the elemental salt is (relatively) permanent, while emanation activity decreases rapidly (a matter of great importance in considering the question of dosage).

In the clinical experiments about to be considered, the emanation was used as being, obviously, the better method for production and control of the negative electron. Having found the minimum beta ray dosage which would bring about the desired biologic cell change without excessive tissue destruction, we were ready to proceed in the experimental treatment of intra-abdominal, as well as surface and body cavity malignancy, with perfect safety to the patient, a status theretofore unknown.

During the past two years and several months, we have had under experimental

TABLE I

CASES TREATED BY FRACTIONAL ROENTGEN THERAPY

Location	Clinically Well	Improved	Unimproved	Dead	Number
Skin (basal cell type)	4	8	0	0	12
Skin (squamous cell type)	7	4	0	5	16
Tonsil	1	0	1	0	2
Tongue	0	1	0	0	1
Larynx	0	0	0	1	1
Breast	14	9	2	6	31
Stomach	0	8	0	3	11
Uterus	2	7	2	4	15
Bladder	0	2	0	2	4
Rectum	0	4	0	1	5
Prostate	0	0	1	0	1
Pancreas	0	0	0	1	1
Jaw	0	1	2	0	3
Parotid	0	1	0	0	1
Kidney	0	1	0	0	1
Eye	0	1	0	0	1
	28	47	8	23	106

Total number of cases admitted for treatment = 232
Carcinoma = 106
Sarcoma = 14
Prophylaxis = 5 (all clinically well)
Non-malignant tumors = 13 (2 clinically well: 11 improved)
Of the 13 cases of sarcoma, 2 clinically well
3 improved
2 unimproved
5 dead
1 condition unknown

In the remaining 92 cases a follow-up examination has been impossible or the period of treatment too short in duration to warrant a report.

Of the total number of malignant tumors referred for roentgenotherapy, 17.6 per cent have been verified by pathologic section and 7.3 per cent by roentgenographic studies.

TABLE II

CASES TREATED BY RADON IMPLANTATION

(Fractional dosage)

Location	Clinically Well	Improved	Unimproved	Dead	Unknown	Number
Carcinoma						
Skin (basal cell type)	37	8	3	2	4	54
Skin (squamous cell type)	5	6	7	8	3	29
Tonsil	3	2	2	6	0	13
Tongue (and tonsil)	1	2	1	4	0	8
Larynx (cords)	2	4	2	3	1	12
Larynx (true)	1	1	1	1	0	4
Breast (skin)	3	0	0	0	0	3
Pylorus	0	3	0	0	0	3
Uterus (disseminate)	0	3	2	2	0	7
Bladder (papillary)	5	4	2	3	2	16
Bladder (infiltrating)	1	2	2	6	0	11
Rectum	1	4	1	5	1	12
Prostate	1	2	1	1	0	5
	60	41	24	41	11	177
Sarcoma						
Orbit (melanoma)	1	0	0	1	0	2
Maxilla (epulis type)	0	1	0	0	0	1
Parotid (mixed type)	2	3	1	3	0	9
Back	2	0	0	0	0	2
Buttock	1	1	0	0	0	2
	6	5	1	4	0	16

treatment, by this method, a number of malignant conditions (of both cellular and connective tissue type) and have had ample opportunity to compare it with other methods of therapy. (See Table II.) We fully realize that a period of less than three years

is entirely too short to justify the quoting of end-results; however, we feel that sufficient time has elapsed to justify our contention as to the integrity of the mode and the efficiency of the method.

For the purpose of verifying our animal experimentation and its application to the treatment of human malignancy, clinical research was undertaken and conducted in the following manner. A number of superficial malignant (epitheliomatous) lesions were chosen, mainly in various locations on the face, using bare tube emanation implants of various content. As the results were practically identical in all lesions treated, one illustration will suffice.

The case under consideration was an epithelioma (rodent ulcer type) of long duration, involving an area of approximately three square centimeters, on one side of the nose. In the first square centimeter a tested "seed" of ½ mc. content was implanted; in the second square centimeter, ¼ mc., and in the third, ⅛ mc., giving an accumulative dosage of approximately 50 to 60, 25 to 30, and 12 to 15 mc. hrs. per square centimeter of tissue involved, respectively. The initial reaction from the three "seeds" was as follows: Marked inflammatory reaction in Area No. 1, less marked in No. 2, and practically none in No. 3. The end-result in these three areas was as follows: Area No. 1, gross tissue destruction, leaving an opening about 4 mm. in diameter through the entire thickness of the ala; Area No. 2, complete healing, leaving a deeply excavated scar and some contracture; Area No. 3, complete healing, with flexible scar and no contracture.

Upon the minimum dosage indicated by the findings of these experiments our succeeding therapy was based; so, to avoid reiteration, it will be understood that where treatment by implantation was used, in the cases herewith reported, the dosage was ⅛ mc. per cubic centimeter of pathology.

As a matter of interest, however, it may be mentioned that in the very superficial lesions, *i.e.*, of less than one centimeter in depth, we have experimented in a number of cases by simply applying the "seeds" externally (⅛ mc. content per sq. cm.), leaving them in place *for only twenty-four hours*, the dosage of beta radiation in this instance being 2 to 5 mc. hours.[6] The results in cases so treated have demonstrated that complete healing is brought about by this exceedingly small dosage, showing that a fractional amount of beta ray application will supply sufficient electron production to bring about complete biological alteration. In lesions of more than one centimeter depth, we have found that the implantation of at least ⅛ mc. for its "life" of approximately thirty days (with an accumulative dosage of 12 to 15 mc. hrs.) is necessary in each cubic centimeter of pathology.

We feel, however, that under certain circumstances the beta ray dosage required is best obtained (as secondary beta radiation—electron formation) from screened tubes of the element, in sufficient quantity. (See Figure No. 1, illustrating graphically the ultimate electron formation from radium element.) This form of radiation is resorted to in the following conditions: Prophylactic radiation in areas of considerable extent, without appreciable pathology (the "lymphatic collar," for instance); in the treatment of simple adenofibroma of the prostate by the "cross-fire" method; in the intra-uterine radiation of malignancy, myofibroma, and myopathic hemorrhage; in deep seated malignancies of annular type (esophagus, rectum); in malignancy of the epiglottis and cords, without tracheotomy (in this instance, for fear that the implants might be accidentally loosened and inhaled); in splenic radiation for myeloid leukemia; for post-operative prophylactic radiation of the axilla in breast malignancy, and, pos-

[6]Approximately one-half of the entire beta ray output of the "seed" is given off during the first four days of its "life."

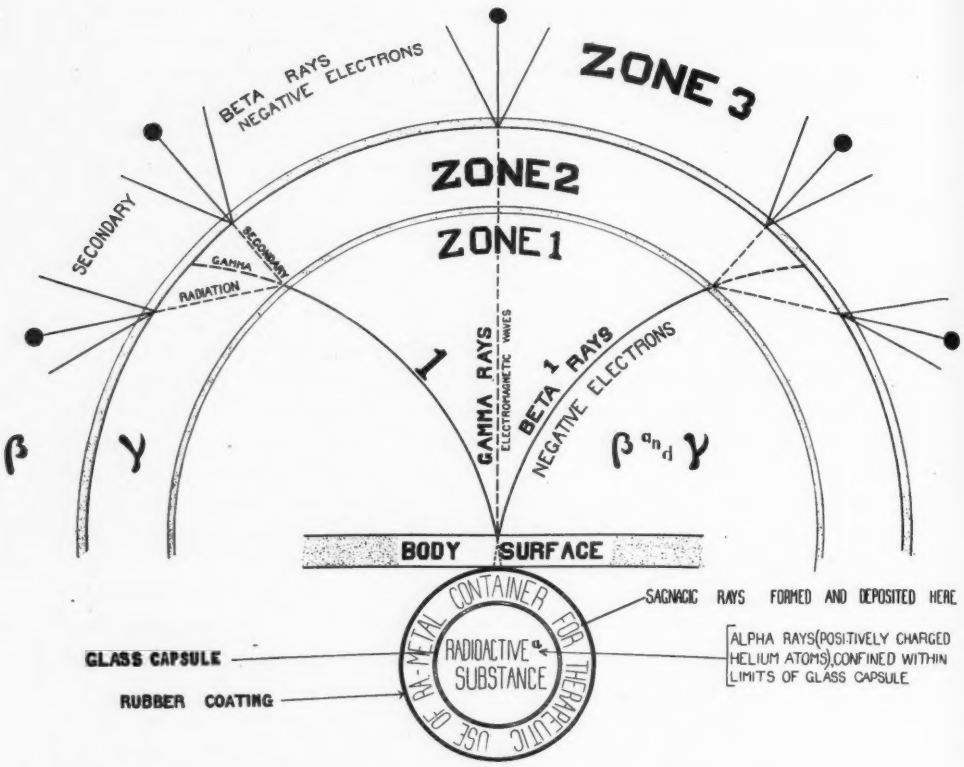


Fig. 1. Diagram illustrating the ultimate electron production, radium element.

sibly, some other instances. In such cases, however, we feel that our contention as regards the use of only the *necessary* beta ray production (whether it be original or secondary) still holds good, if we are to achieve complete biological cell change without gross tissue destruction.

Let us now briefly consider some of the clinical results obtained by the use of implantation with unscreened emanation tubes of fractional content. The results in epithelioma of the face have been referred to, and it can be understood readily how necessary it is to avoid gross sloughing and scar contracture when these lesions involve the eyelids and canthi, as they frequently do; to a lesser degree the same is true in malignancy of the nose and at the angles of the mouth. Extensive lesions of longstanding about the face, even with periosteal attachment, have yielded to this method with a minimum of scar formation and without contracture. A similar result has followed in the treatment of epithelioma in other superficial body areas. In not a few of these cases both massive dosage of X-ray (primary) and screened radium (gamma radiation) had been employed by ourselves and others without apparent improvement; in fact, some of them had been termed "radium-fast" and had been given up as incurable by radiation. The results following the use of fractional beta radiation, correctly applied, were as surprising as they were satisfactory. It may be said that in the great majority of cases these results (complete healing without destruction) have been permanent for periods up to more than two years.

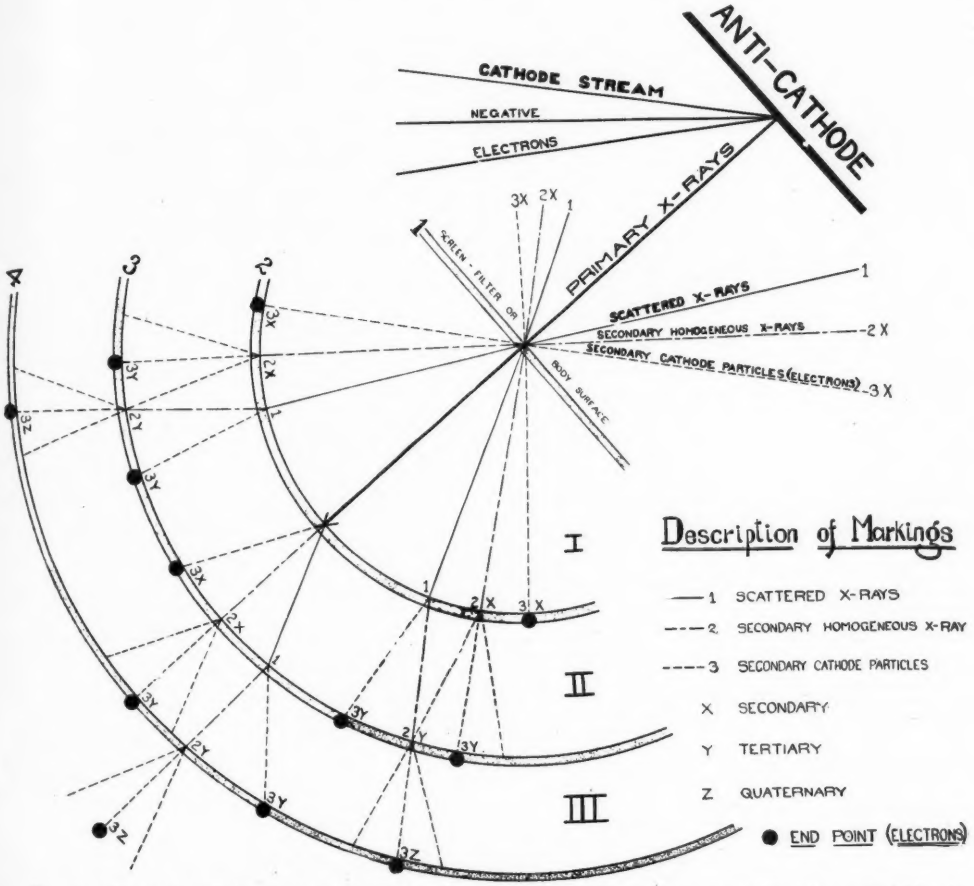


Fig. 2. Chart illustrating theoretical mode of action of the X-ray and necessity of penetrability in the treatment of internal malignant neoplasms. Disintegration of rays takes place in all directions; however, for sake of simplicity only the downward disintegration is represented in the chart.

In advanced cases (squamous cell type) with lymphadenopathy, the appreciable glands have been treated by implantation with very marked retrogressive change (these glands, so treated, never entirely disappear, but become atrophic and fibrotic and upon section frequently show no evidence of malignancy). However, to bring about anything more than palliation we must be positive that the *terminal* dissemination has been reached and the *entire* pathology subjected to radiation. This statement, of course, holds good in the original lesion as well as the dissemination, and applies to all known forms of therapeutic attack in cancer.

In order to cover our experiments in radium therapy by this method, in as brief a manner as possible, we will group tumors treated according to the following classification: Those of the head and face, neck and chest, abdomen and pelvis—a rather unusual but effective method of division.

In the study of malignant neoplasms of the eye and orbit, special attention should be called to epithelioma involving the eyelids and canthi. Here the method of therapy, as described, has been followed by complete healing without excessive scar formation or tissue destruction; some of these cases were of longstanding and had

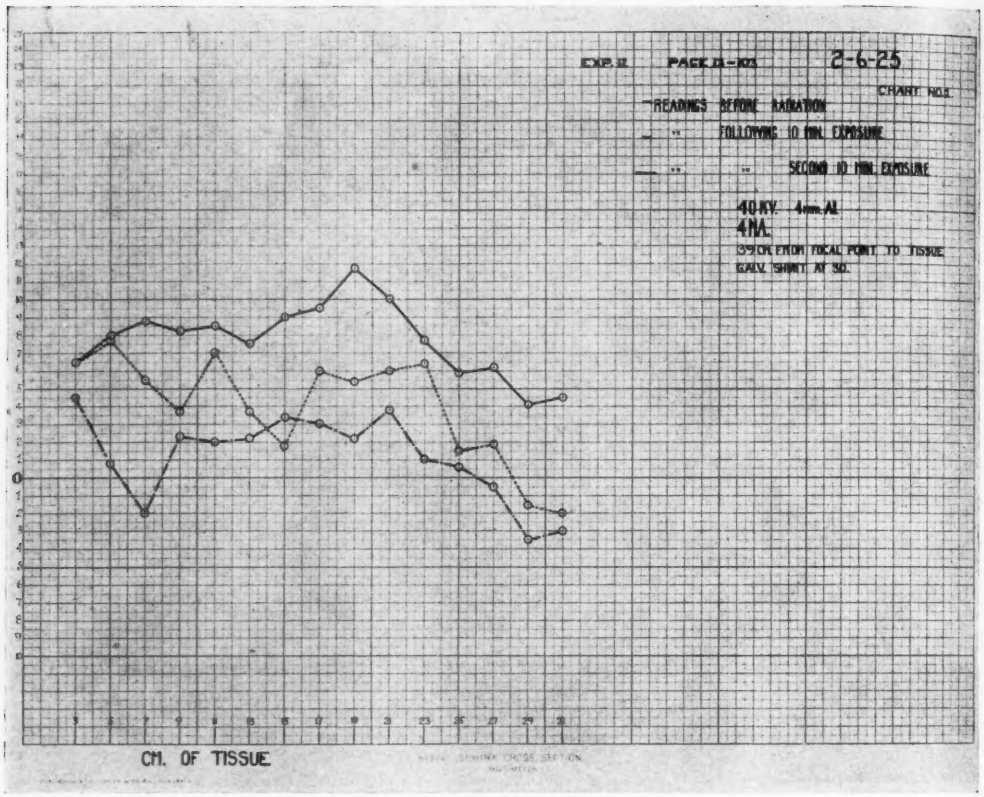


Fig. 3. See explanation in text, page 63.

failed to respond satisfactorily to large dosage of the screened element. We have had under this form of treatment cases of melanosarcoma (melanoma) of the eye and orbit, these being early recurrent pathologies following enucleation. In one case the orbital pathology entirely disappeared, while in another the local result was equally good, but there was apparent intracranial dissemination. The first patient is living and symptom-free; the second patient died two months after operation.

In epithelioma of the lip, especially of the lower lip, we feel that the original area should be removed by excision or electrocoagulation (preferably the latter), and either prophylactic or alterative radiation be employed in the "lymphatic collar" area (according to the clinical status of the individual case). In the absence of frank glandular enlargement, however, we prefer to use secondary beta radiation from the screened element, or from the roentgen tube. In cases of demonstrable adenopathy the implantation of fractional emanation has been followed by the most satisfactory result. Always bear in mind, however, that complete success will follow only when the terminal invasion has been attacked.

Carcinoma of the tonsil has shown better and more lasting results when treated by this method than followed the application of screened element in plaques or tubes or the introduction of needles, and is accompanied by no danger of major blood vessel destruction.

In malignancy of the tongue most of our experiments have been confined to post-

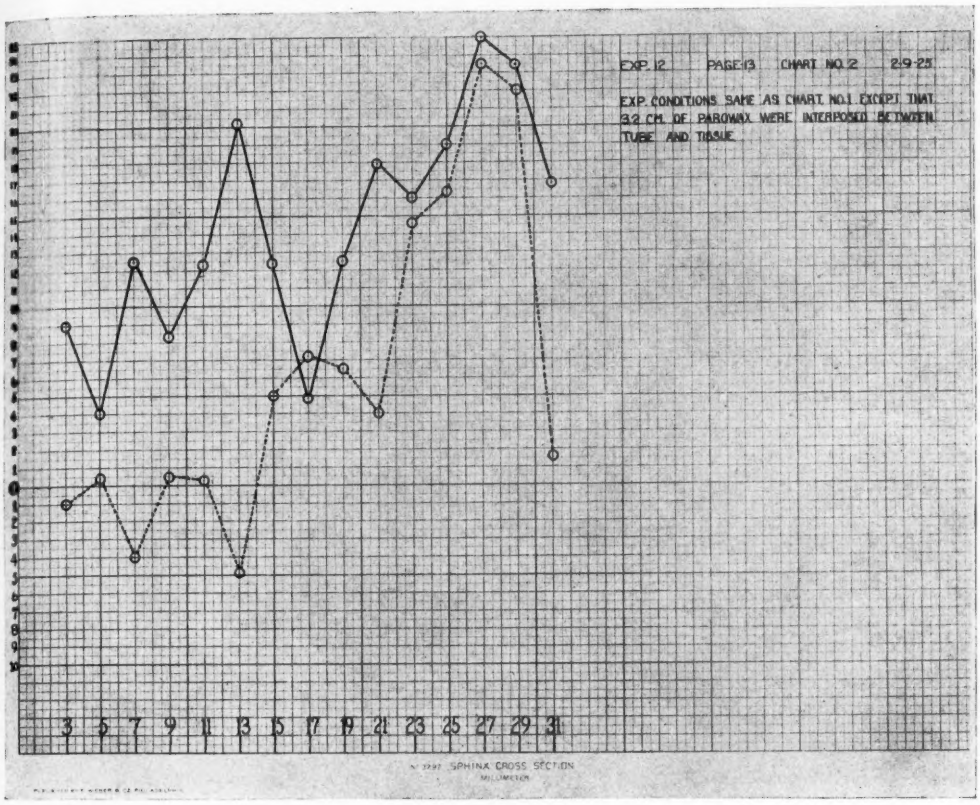


Fig. 4. See explanation in text, page 63.

operative prophylactic radiation and were followed by good local results. In two inoperable cases, however, this method was used as the only therapy; in both, there was involvement of the tonsil. The local result was good in both instances: the first patient died from general dissemination; the second is alive and in good local and general condition; there was no sloughing in either case.

We believe that radiation therapy, by any method, is indicated only as a palliative in extrinsic carcinoma of the larynx, but in the intrinsic variety much more may be expected. We have had considerable experience with these cases and, as has been said, feel that when the pathology is confined to the region of the epiglottis and cords secondary beta radiation should be employed. When the true larynx is involved our results following the implantation method have been far superior to those following the introduction of needles or cross-firing with heavy dosage externally applied. In these cases a preliminary tracheotomy is always done, and, later, a laryngo-fissure is made, with bare tube implantation of the entire pathologic area, followed by immediate wound closure. Marked retrogression in the growth has followed and we feel that this method offers more than any other in this frequently fatal condition. A very interesting fact is connected with the tracheotomy done in these cases. For years we have found that secondary involvement of the tracheotomy wound was not infrequent, but following the prophylactic implantation of these wounds by fractional emanation

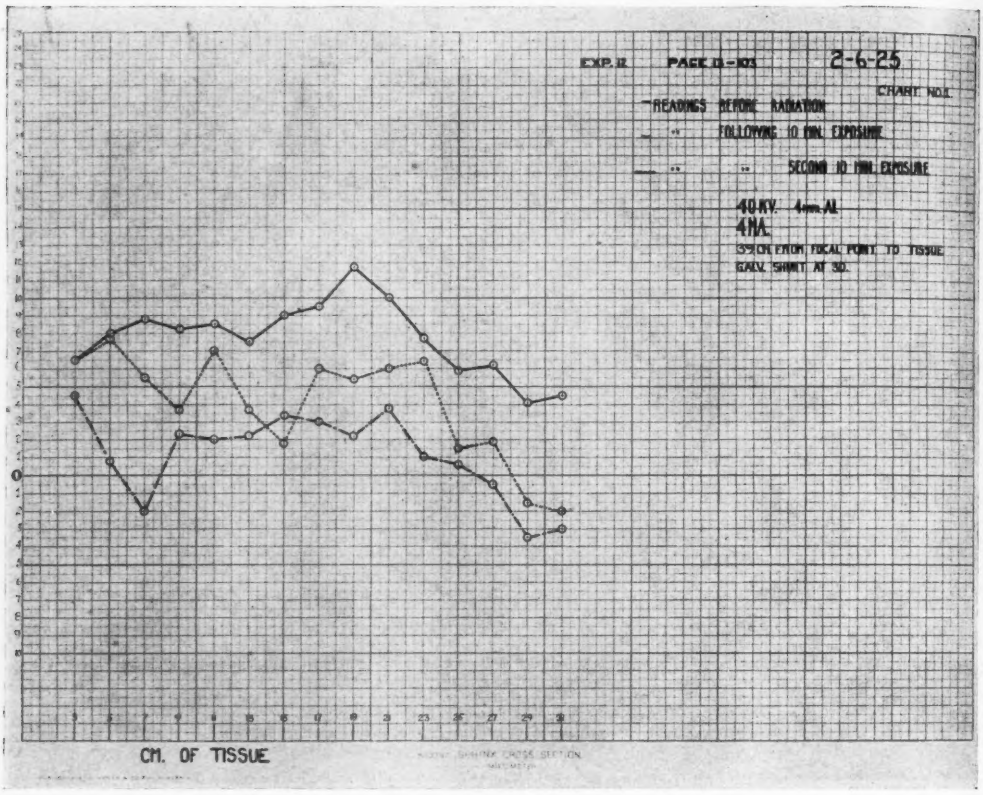


Fig. 3. See explanation in text, page 63.

failed to respond satisfactorily to large dosage of the screened element. We have had under this form of treatment cases of melanosarcoma (melanoma) of the eye and orbit, these being early recurrent pathologies following enucleation. In one case the orbital pathology entirely disappeared, while in another the local result was equally good, but there was apparent intracranial dissemination. The first patient is living and symptom-free; the second patient died two months after operation.

In epithelioma of the lip, especially of the lower lip, we feel that the original area should be removed by excision or electrocoagulation (preferably the latter), and either prophylactic or alterative radiation be employed in the "lymphatic collar" area (according to the clinical status of the individual case). In the absence of frank glandular enlargement, however, we prefer to use secondary beta radiation from the screened element, or from the roentgen tube. In cases of demonstrable adenopathy the implantation of fractional emanation has been followed by the most satisfactory result. Always bear in mind, however, that complete success will follow only when the terminal invasion has been attacked.

Carcinoma of the tonsil has shown better and more lasting results when treated by this method than followed the application of screened element in plaques or tubes or the introduction of needles, and is accompanied by no danger of major blood vessel destruction.

In malignancy of the tongue most of our experiments have been confined to post-

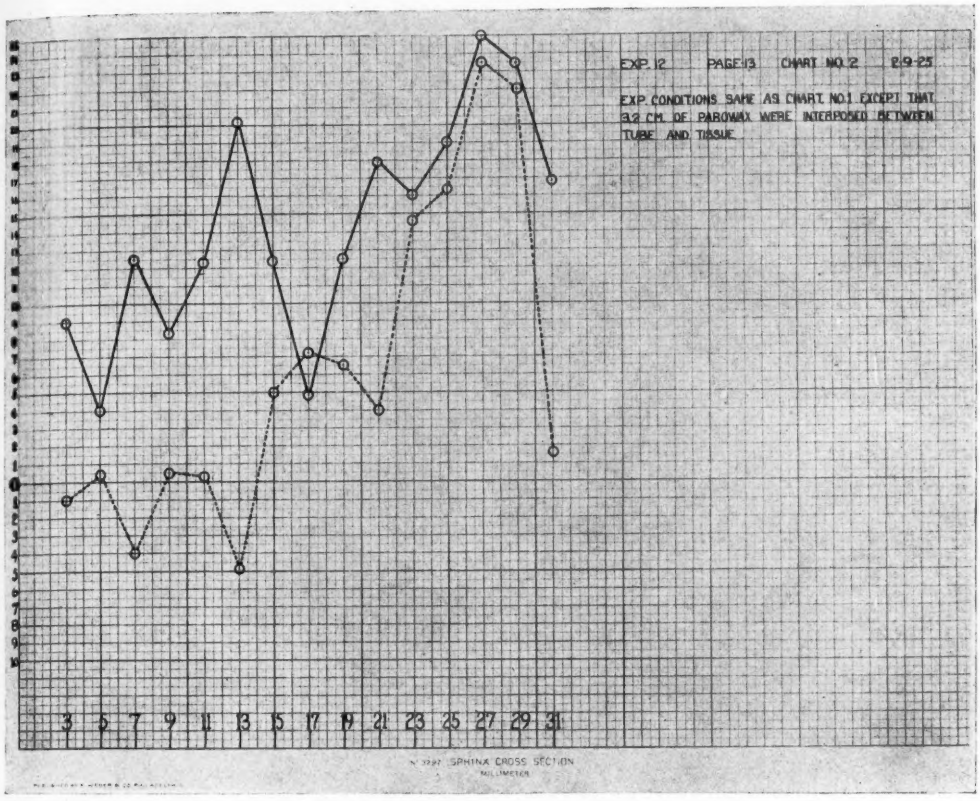


Fig. 4. See explanation in text, page 63.

operative prophylactic radiation and were followed by good local results. In two inoperable cases, however, this method was used as the only therapy; in both, there was involvement of the tonsil. The local result was good in both instances: the first patient died from general dissemination; the second is alive and in good local and general condition; there was no sloughing in either case.

We believe that radiation therapy, by any method, is indicated only as a palliative in extrinsic carcinoma of the larynx, but in the intrinsic variety much more may be expected. We have had considerable experience with these cases and, as has been said, feel that when the pathology is confined to the region of the epiglottis and cords secondary beta radiation should be employed. When the true larynx is involved our results following the implantation method have been far superior to those following the introduction of needles or cross-firing with heavy dosage externally applied. In these cases a preliminary tracheotomy is always done, and, later, a laryngo-fissure is made, with bare tube implantation of the entire pathologic area, followed by immediate wound closure. Marked retrogression in the growth has followed and we feel that this method offers more than any other in this frequently fatal condition. A very interesting fact is connected with the tracheotomy done in these cases. For years we have found that secondary involvement of the tracheotomy wound was not infrequent, but following the prophylactic implantation of these wounds by fractional emanation

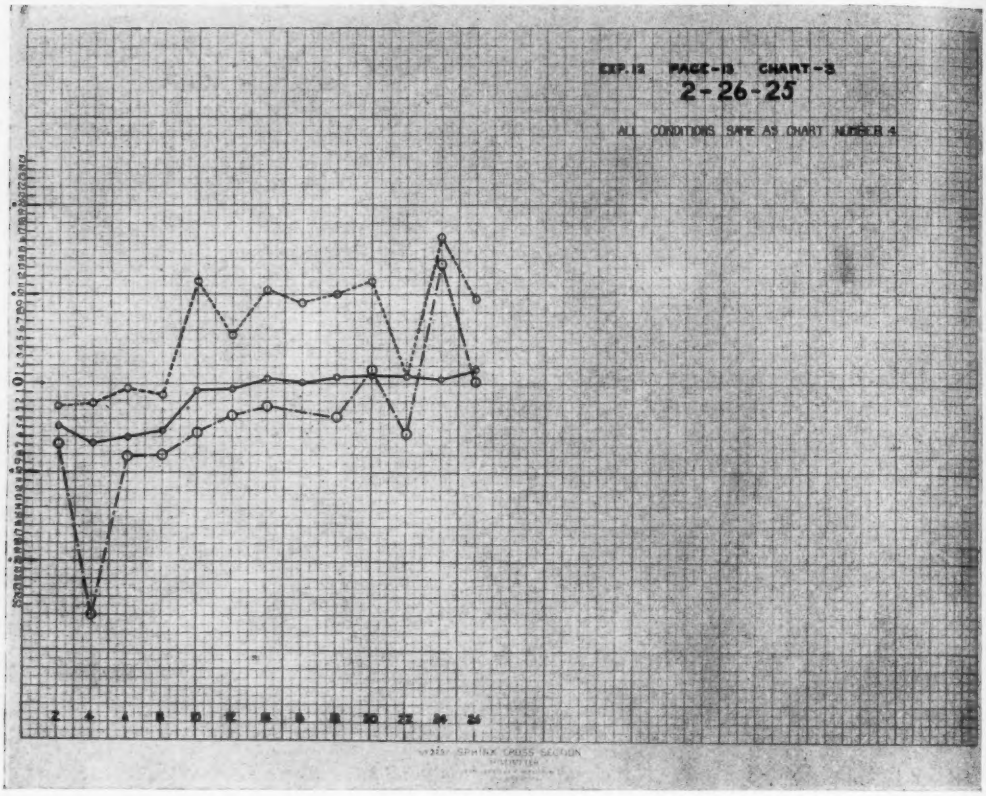


Fig. 5. See explanation in text, page 63.

dosage we have yet to have this condition manifested in any case.

We have had under treatment several cases of sarcoma and mixed tumor of the parotid. In one, attacking the original pathology without operation; in others, following partial removal of the gland, and, also, in the lymphadenopathy of the submental and submaxillary nodes. The original lesion so treated became atrophic and has so remained, without glandular dissemination. (It is to be noted, however, that there was no tissue section diagnosis made in this case.) In other cases where—for anatomical reasons—it was impossible to remove the entire pathology, the remaining portion of the growth as well as the operative wound and surrounding structures were implanted and the nearest chains of lymph glands radiated prophylactically. There has not been a recurrence in any of these cases, and this is particularly noticeable in view of the fact that, without such treatment, incomplete removal of parotid pathology is very frequently followed by early local recurrence and glandular dissemination. Cases with post-operative local recurrence and widespread adenopathy, when referred to us for treatment, have invariably reached an early fatal termination, despite all forms of therapy. Four cases of sarcoma of the back have been given post-operative prophylactic treatment by this method, without recurrence.

Our only experiments by this method in cancer of the breast have been in recurrent localized skin lesions, as we feel that the major original pathology should be excised, the axillary prophylaxis done by means of

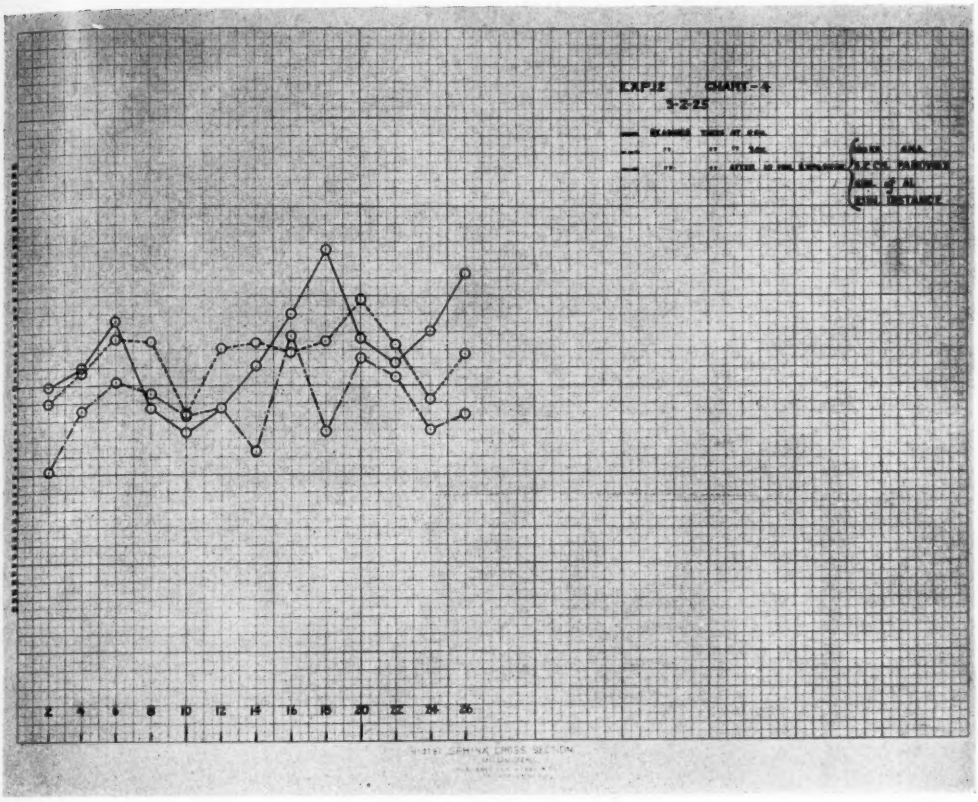


Fig. 6. See explanation in text, page 63.

secondary beta radiation from screened tubes, and that the prophylaxis of wide areas of the chest wall, as well as widespread recurrence, should be treated by roentgenotherapy (secondary corpuscular radiation). In these limited areas of recurrence, however, the result following implantation has been a total disappearance of the pathology, without sloughing.

Our treatment of intra-abdominal and intra-pelvic malignancy by this method has, so far, been limited to lesions of the pylorus and the uterine adnexa, without adenopathy. If there is marked involvement of the lymph nodes present, we feel that much better results can be obtained by general secondary radiation from the roentgen tube. In inoperable carcinoma of the pylorus—and following posterior gastro-enterostomy — the entire pathologic area was implanted and the abdomen immediately closed. There were no unusual post-operative symptoms. Subsequent roentgenograms have shown decrease in the tumor mass in each of the three cases so treated. Up to this time the patients have gained in weight and are in good physical condition.

In uterine malignancy we feel that the original lesions of the portio vaginalis are best treated by secondary beta radiation and the cancerous conditions found in the upper true cervix and fundus are strictly operable, with post-operative prophylactic radiation of both the vaginal vault (by radium therapy) and the pelvis and lower abdomen (by roentgenotherapy). While our results in the treatment of malignancy of the portio

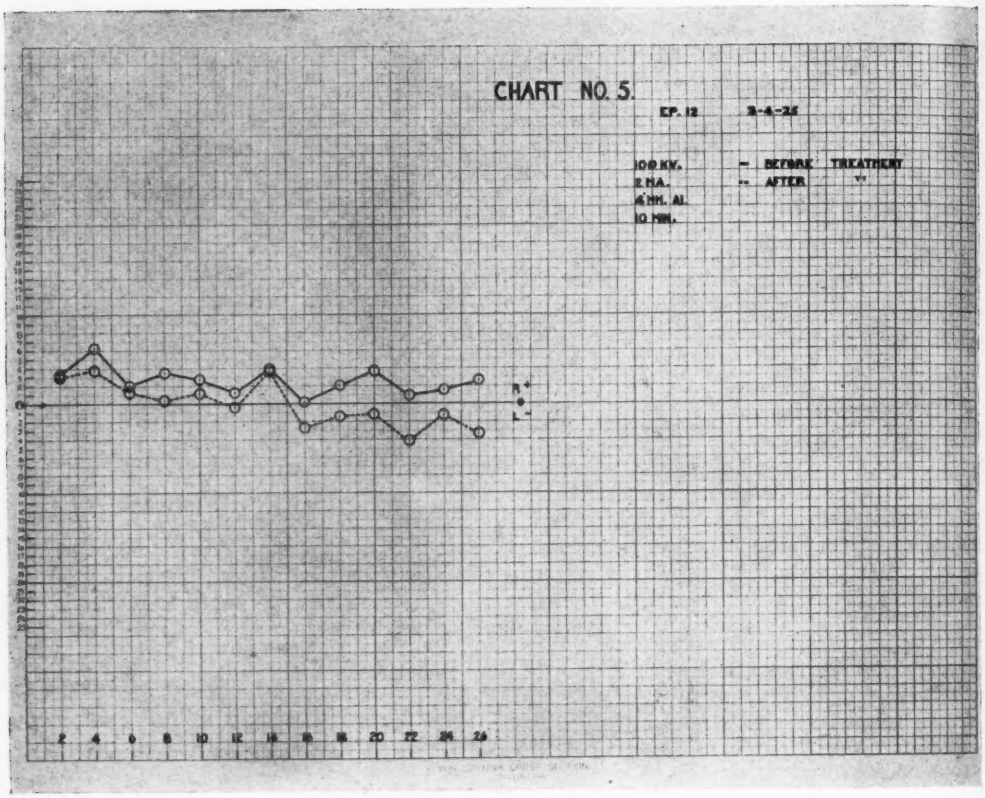


Fig. 7. See explanation in text, page 63.

vaginalis by secondary radiation have been uniformly good, as regards the local pathology, there have been a majority of these cases go on to dissemination into the adnexal areas, and it is in such conditions that we hope the method here advocated will be of marked benefit. We have had seven of these cases under treatment by fractional implantation, and their immediate post-operative progress was most satisfactory. The end-results, so far, are promising. We have worked out a safe and simple method for the thorough exploration, illumination and implantation of the adnexal areas of involvement, through the open abdomen.[7]

Many of our experiments in fractional beta therapy have been done in malignancy of the urinary bladder, this organ offering an especially good field for such work. Here not only can the bare tubes be implanted under direct vision but both action and reaction, as well as end-result, can be noted by subsequent cystoscopic examinations. In the more widely spread pathologies, however, it is frequently necessary that such implantation work be done through a suprapubic opening. It is only necessary to say here that in our hands this method of radium therapy in bladder malignancy has been followed by better results than any other, and that we have yet to see a single case, so treated, develop gross tissue destruction or perforation. It must be understood, however, that the above statement refers to a local condition and a local result and has no bearing upon extra-vesical dis-

[7]One of the writers has in preparation an article on this technic—to appear in the current literature in the near future—to which those interested in this work are referred.

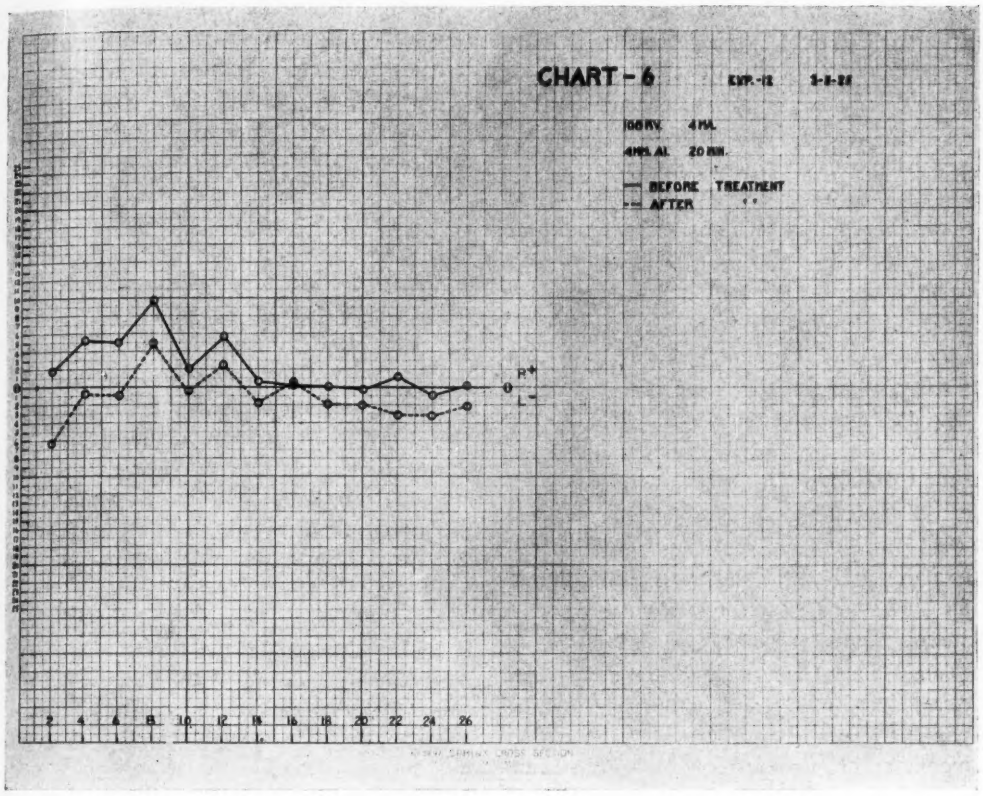


Fig. 8. See explanation in text, page 63.

semination, a status which for its treatment must depend upon widespread secondary radiation. Our best results have been in the degenerating papillary type: the infiltrating type shows early extra-vesical dissemination.

Following preliminary colostomy and prostatomy, we have used the implantation method, prophylactically, in several cases of carcinoma of the rectum without local recurrence; however, we feel that in this particular area such prophylactic radiation is preferably done by means of the roentgen tube. In annular rectal lesions we prefer to make use of centrifugal secondary radiation from screened tubes of the element, and such treatment has been followed by fibrotic change in the pathology, allowing digital dilatation without bleeding or discomfort. In localized lateral wall invasion the implantation method is the better plan, if radiation therapy is used to the exclusion of surgical interference. In four cases, so treated, there has been very marked improvement for periods up to two years and more, but here, again, we must understand that such improvement is local only and dissemination is probable unless early prophylactic radiation of the pelvis and perirectal structures is employed.

Prostatic malignancy will frequently react favorably to radium therapy. We have used in this condition cross-firing from the screened element in the rectum and urethra, combined with introduction of element-bearing needles into the immediate pathol-

ogy, but the results obtained do not compare with those following the implantation of fractional emanation dosage. Following the former method, gross tissue destruction has not infrequently occurred, but this has never happened when the proper dosage of original beta radiation was employed. Thorough implantation of the entire pathology is made through a perineal incision (as for perineal prostatectomy). Three patients treated by this method are alive and well at this time and examination shows marked retrogression in the prostatic pathology. These cases were selected, that is to say, we felt reasonably sure the malignancy was confined within the capsule. Given extracapsular dissemination and bone involvement, implantation of the prostatic pathology alone will mean only palliation, no matter how satisfactory the local result may be.

Our results, experimental and clinical, in this method of radium therapy having been covered as briefly and comprehensively as possible, we will now consider the experimental and clinical results obtained by radiations from the roentgen tube.

This investigation was carried out with a twofold object and purpose in view: first, to substantiate results obtained from our radium research, and, second, because we realized that *proper* roentgenotherapy had a wide field of usefulness in preventive and combative cancer control, which made it more adaptable to our purpose and efforts than radium therapy, under certain conditions. When starting this experimentation we were confronted with the problem of determining the best method of electron formation. This once ascertained it was necessary to regulate tube conditions so as to bring about similar results with generated radiations to those obtained from the spontaneous ones, *i.e.*, biologic cell change without destruction.

Limited space prohibits a detailed description of the great amount of work necessary to develop the results about to be reported. It became necessary to develop an adequate method of electron production for treatment of superficial pathologies and another for deep-seated conditions, and to regulate both to prevent gross tissue destruction. Through prolonged and carefully controlled electroscopic and galvanometric determinations we finally found that a sufficient thickness of paraffin ("parowax") interposed between the tube and the material to be radiated was very adaptable for our purpose. By varying the thickness of the paraffin, the distance from the paraffin to the radiated surface, the voltage, milliamperage, nature and thickness of metal filters employed, we eventually developed a technic which has yielded excellent results in the treatment of surface and subcutaneous pathologies.

The conditions employed for the treatment of surface cases were as follows: Paraffin (3.2 centimeters) was placed directly over the area to be treated (if ulcerated, the lesion was covered with sterile gauze and the parowax laid upon this). A two- to ten-minute exposure was given, using 100 K.V., 4 mm. of aluminum, and with the focal point of the tube about 24 inches from the paraffin surface; the cone employed depends upon the divergence of the rays required to cover the area to be treated.[8]

Table No. 1 describes types, and results obtained in surface and deep-seated conditions so treated. In the treatment of deep-seated malignancies, the problem of electron production and control became somewhat more complex, and thus necessitated extended research and study beyond that already determined for the treatment of superficial conditions. (See Fig. 2, illustrat-

[8]It was found by means of electroscopic determinations and animal experimentation that 1.6 cms. of paraffin did not sufficiently split up the primary beam for the desired treatment of superficial conditions, while 4.8 cms. reabsorbed some of the secondary corpuscular rays formed during the passage of the primary beam through the medium. Therefore, 3.2 cms. has been found most satisfactory to meet the requirements.

ing graphically the ultimate electron production from primary X-rays.)

The plan adopted for this experimental study was as follows: Two celluloid cylinders of equal length and diameter (30 cms. $\times$ 5 cms.) and accurately perforated each 2 cms., were filled as uniformly as possible with fresh ground tissue. We attempted to obtain a uniform mixture of all forms of tissue so as to simulate body conditions as closely as possible. A wire, connecting the two cylinders, was placed through the bottom perforations into the ground contents. This wire remained unaltered throughout the experiment. Another wire was connected from the upper perforation of one cylinder (2 cms. from top surface of cylinder) to one binding post of a galvanometer of extremely high sensitivity, while a third wire, similar to the other two, extended from the upper perforation of the other tube to the other binding post of the galvanometer. The two wires connecting the two cylinders with the binding post of the galvanometer were moved uniformly from the first hole in each tube (2 cms. from top of cylinder), to the next to the last perforation in each cylinder (26 cms. from top of cylinder), the last perforation being occupied by the coupling wire. At each perforation a reading was made. This was continued until constant readings in one direction were obtained throughout the entire length of the cylinders. After this was determined, the cylinder acting as the *positive* pole of the circuit (the phenomenon *always* displayed by the experimental tumors) was placed under the roentgen tube. The other cylinder and the galvanometer were properly protected from scattered rays during the exposure. After the exposure was made the two cylinders were connected as before and galvanometric readings made at each two centimeters, as before the exposure. It might be stated that readings were made each minute.

Limited space prohibits a detailed description of the results obtained; we therefore offer the accompanying charts which illustrate the point under consideration. (Figs. 3–8). Analysis of the charts obtained from experimental observations demonstrates that the maximum physical effect due to radiation is produced within the first fifteen centimeters of tissue traversed. From this point on, until we near the bottom of the cylinder, there is little physical alteration, due to the fact that between these limits there is a deficiency of corpuscular radiations. As we approach the lower limits of the tube, however, there again is noticed a marked reduction in potential to that displayed by the same tissue before radiation. This can be explained by considering that at this point the tissue is affected by reflected radiations formed by the splitting of the beam when striking the dense medium of the table holding the tube during the exposure, and to the fact that at this point some of the secondary X-rays formed above are giving rise to tertiary corpuscular radiations.

These experiments, together with animal experiments conducted to determine the effective depth dosage, have led to the establishment of a secondary corpuscular ray treatment for intra-abdominal, chest and pelvic pathologies.

At the present time an elaborate experimentation is being conducted to determine the best conditions under which to treat each and every centimeter of tissue, during the passage of the rays through it. Special experimental apparatus has been designed whereby determinations (electroscopic) are made under the following conditions:

(*a*) varying voltage
(*b*) varying milliamperage
(*c*) varying distance from focal point of tube to tissue surface
(*d*) varying time
(*e*) varying thickness of tissue
(*f*) varying metal filters
(*g*) varying special filters

For radium therapy:

(*a*) varying amount of elemental salt or sealed radon
(*b*) varying time
(*c*) varying thickness of tissue
(*d*) varying screens

The electroscopic determinations once made, the biologic effects, under above mentioned conditions, are checked upon the growth and development of chick embryo and later upon animal tumors.

This work, due to its magnitude, will require an extended period of time before accurate results may be formulated and reported. However, we have advanced far enough so that we may regulate human therapy with fair accuracy.

Having determined the depth at which the greatest physical effect is brought about under varying tube conditions and filter control, we have been able to direct the secondary rays (electrons) to the desired locality and at that point utilize the electrons in quantities necessary to produce the desired biologic change without destruction, either at that point or any intermediate point exposed to the rays. Under this method of roentgenotherapy have come 232 cases (mostly inoperable and many diagnosed as hopeless) of abdominal, chest and pelvic malignancies (Table No. 1). Many of these cases had been previously treated by means of "deep therapy" without noticeable change, and, due to their location, extent, or other conditions, were not appropriate for radium therapy. However, the majority of them have yielded surprisingly well to short repeated exposures to secondary corpuscular radiations.

The voltage employed in directing these treatments varies between 75 and 100 K.V., the milliamperage is the same as in the treatment of surface lesions (4 ma.), the time of exposure ranges from 10 to 20 minutes. When the smaller dosage is used the treatments are repeated weekly, while those patients receiving the larger doses report every three weeks. The disturbing constitutional effects of the massive doses are, by this method, greatly reduced, the local reactions eliminated, the results—at least to date—superior to those from any method of roentgenotherapy heretofore employed.

SUMMARY OF ACTION AND RESULTS

We have considered and experimentally substantiated in many of its phases a theory of oncologic histogenesis and upon this have constructed an effective method of roentgen and radium therapy.

Experimentally we have demonstrated the theory to be sound; the method of therapy has produced results, experimentally and clinically—*that* is the ultimate goal of every worker engaged in combating this malady.

In closing this report, we will attempt a suggestion as to the possible *modus operandi* of the electron within the body tissues and, in so doing, further support the theory of etiology. We will attempt to further illustrate the logic of equilibrating quantities of electrons in treating malignancy, and the mechanism of excess radiation (electron concentration).

As far back as 600 B. C. (Thales of Miletus) the phenomenon of electrostatic attraction was observed. In 100 A. D., Plutarch recorded that a piece of lodestone sometimes attracted and sometimes repelled iron. Observations from these times on brought about the establishment of the law —by DuFay (1733)—"unlike electricities attract; like electricities repel."

In our present century, Bohr, in describing the structure of the atom, stated: "We could indeed hardly conceive of a system composed of four positive hydrogen nuclei alone, for the forces of repulsion would soon drive the separate parts asunder. The two electrons can, so to speak, serve to hold the system together."

Applying the laws of attraction and repulsion to the electrical structures of the

cell, as outlined in this report, we may view the problems of roentgen and radium therapy as being based on such fundamental principles.[9]

If neoplastic tissue exists in an electro-positive state as compared to normal tissue, we could naturally expect it to have a greater affinity for electrons than would the normal tissue. This attraction of the positive tissue for negative electrons we believe to be manifested in the fact that the "cancer cell" is more radiosensitive than is the normal cell.

However, this affinity of neoplastic tissue for electrons has—like any electro-chemical phenomenon—a capacity to place the cell in a condition of equilibrium. This state of balance is what we have attempted to attain and maintain. Here we have the application of the law of electrostatic attraction—"unlike electricities attract."

On the other hand, it is equally well known that "like electricities repel," and in this law we find part of the explanation of the "caustic" action of excess radiation; for in saturating the cell with electrons there must result a mutual repulsion of similarly charged elements, and under these conditions we could no more expect the cell to hold together than could we the atom were it not balanced. This, combined with the decreased blood supply to the area exposed to radiation,[10] results in a complete disorganization of the cellular elements, manifested as necrosis and sloughing.

In spite of the profound and beneficial local effect these physical radiations from spontaneous and generated sources may have upon tumors, we are forced to acknowledge and take into consideration their limitations in combating dissemination. With this in mind, one of the writers suggests the use of the anionic (electro-negative) colloids for the treatment of widely disseminated or inaccessible pathologies, or for prophylactic purposes. He has directed the use of colloidal sulphur and iodine (both electro-negative) in advanced and apparently hopeless cases of malignancy, with gratifying results. This is but another method of employing and utilizing the negative electron in fractional or equilibrating proportions.

Recent investigations in many branches of scientific research demonstrate the advance made in our knowledge of the physico-chemical foundation of life's processes, and of the abnormalities in this physico-chemical balance which manifest themselves to us as one disease or another. With this knowledge, and extended research, the future holds out more promise than ever before in the history of medicine.

So conclusive was our physical experimentation that we are now attempting to demonstrate a physical-chemical change in the tissues by means of a thorough research into the hydrogen ion concentration of normal and neoplastic tissue. This investigation has necessitated considerable special apparatus and elaborate technic to overcome the many possible sources of error which might enter into such determinations.

As we believe that the original alteration in tissue undergoing malignant cell change is first physical and secondly chemical, we are now attempting to study the possible chemical change by means of spectroscopic analyses and surface tension determinations of the tissues. These investigations have already offered gratifying results, with extremely interesting findings. The material used for our investigations consists of the following standard strains of experimental tumors: Rat Sarcoma No. 10, Rat Sarcoma No. 39, Flexner Rat Carcinoma, Mouse Carcinoma No. 180, Rous Chicken Sarcoma, also spontaneous rat tumors from the Wistar Institute of Anatomy and Biology, and various forms of human neoplasms, as well

[9] It was the writers' hope and intention that a hypothetical explanation of the biophysical mechanism of mitosis might be described in this report, but due to the space already occupied it must be omitted.

[10] Here we might mention that the blood carries with it a strong electro-positive agent in the form of oxyhemoglobin.

as those occurring in the lower forms of animal life. Other pathologies, aside from neoplasia, will undergo investigation as a check on tumor analyses.

It is the earnest hope and desire of the writers that this report may help to stimulate *scientific* investigation along the lines herewith reported and result in one step farther in combating one of the greatest enemies known to man—*cancer*.

REFERENCES

1. Butts, D. C. A.: Cell Ionization and Its Relation to Malignant Neoplasms. N. Y. Med. Jour. and Med. Rec., July 18, 1923, CXVIII, 89.
2. Idem: Malignant Neoplasms: Colloidal and Electrical Phenomena Observed and Their Experimental and Clinical Aspects. Med. Jour. and Rec., Feb. 20, 1924, CXIX, 196.
3. Idem: A Physical Study of the Electron and Its Application to Pathologic Processes. Hahnemannian Monthly, December, 1924, LIX, 736.
4. Idem: A Theoretical Study of the Biophysical Action of the X-ray in the Treatment of Malignant Neoplasms. Jour. Radiol., Sept., 1924, V, 315.
5. Idem: Some Biophysic and Chemic Properties of Malignant Cell Metabolism, with Special Reference to Combative Therapeutic Measures. Jour. Radiol., July, 1924, V, 221.
6. Idem: Rôle of the Electron in X-ray and Radium Therapy. Med. Jour. and Rec., April 1, 1925, CXXI, 397.
7. Idem: Some Outstanding Physical Considerations in Radium and Roentgen Therapy. Radiology, January, 1926, VI, 47.

A CHART FOR DETERMINING DEVELOPING TIME ACCORDING TO CONDITION OF DEVELOPER[1]

By EDWARD SCHONS, M.D., St. Paul, Minnesota

THE condition of the developer is one of the uncertain variable factors which interferes with the production of uniform radiographic results. The other factors, voltage, milliamperage, the radiographic medium, and the proper exposure, can be quite accurately standardized and variations in results due to these factors eliminated. The effect of weakened developer is, however, not allowed for where the time-temperature method is used, and this is a gradually changing quantity from the time a tank of solution is made until it is discarded as too weak for use, which is often when the radiographic results show that the developer is obviously exhausted.

In the October, 1925, number of the *X-ray Bulletin,* published by the Eastman Kodak Company, Wilsey and Norris describe the Watkins factor method of determining the strength of photographic developer and the necessary time of development. This is a very practical procedure and helps tremendously in obtaining a uniform quality of films without the necessity of wastefully discarding a good developing solution in order always to have a fresh solution. In order to facilitate the routine use of this method I have devised the accompanying chart (Fig. 1). By the use of this chart the condition of the developer can be determined very quickly at any temperature between 65° and 70° F., between which limits we always maintain our solution. The correct time of development at all temperatures between 65 and 70 degrees then can be immediately read off and jotted down on the tabulating sheet (Table 1).

The chart is based on the portion of the Eastman developing curve which is almost a straight diagonal from the point 5 minutes at 65 degrees to 4 minutes at 70 degrees Fahrenheit.

The method of using the chart is as follows: Keep a thermometer in the developing solution at all times and keep the temperature between 65 and 70 degrees. Make an exposure on a 5 × 7 film in an ordinary

Correct Time of Development, According to Condition of Developer as Determined from Chart

		New		
Date of Test		9/2	9/7	9/11
Time of Appearance of Image in Seconds		22	24	30
Temperature of Developer at Time Test is Made		68	70	68
Time of Development In Minutes (from chart)	70°F	4	4¾	5½
	69	4¼	5	5¾
	68	4¼	5¼	6¼
	67	4½	5½	6½
	66	4¾	5¾	6¾
	65	5	6	7

Table 1.

[1]Presented before the Northwest Radiological Technicians' Society, February, 1926.

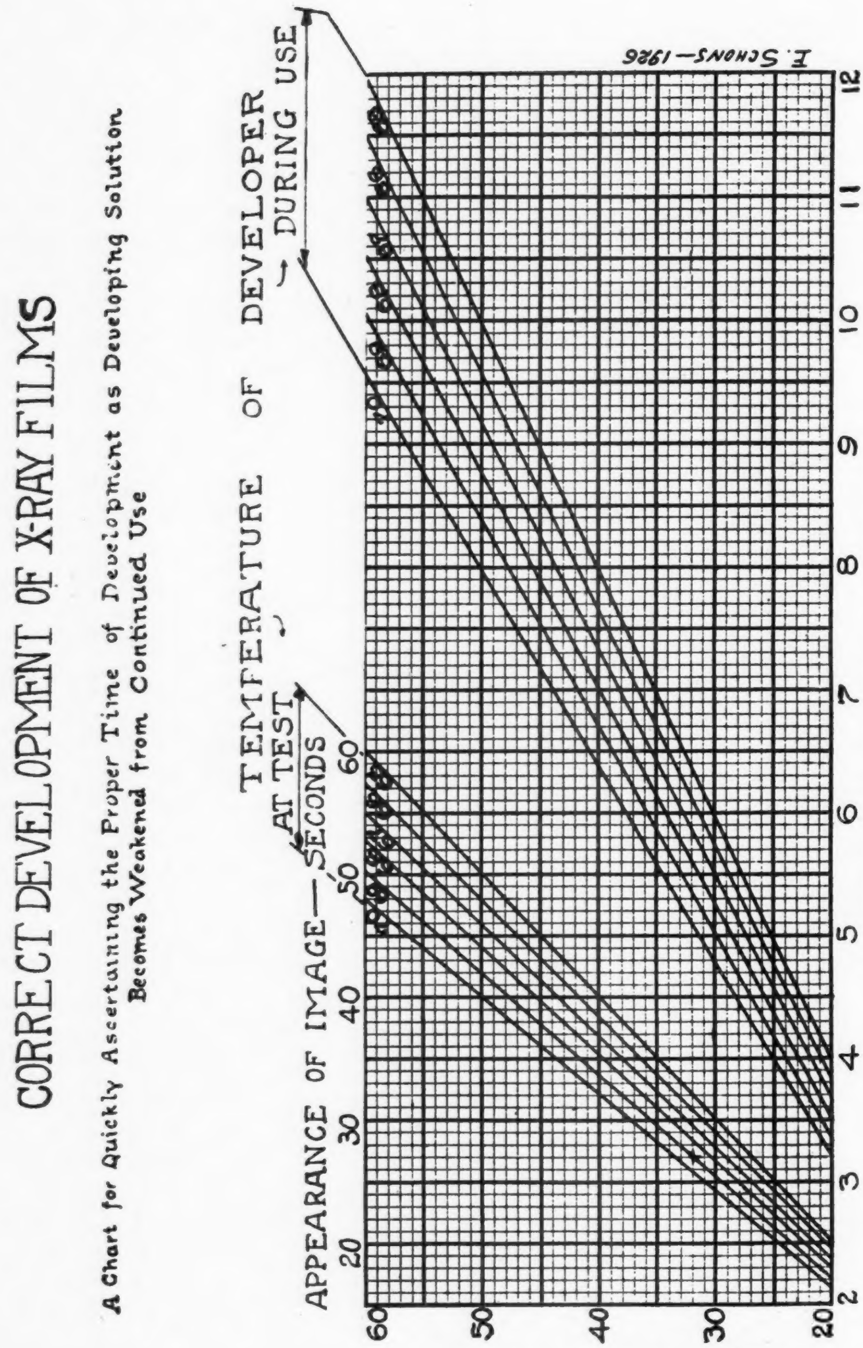

CORRECT DEVELOPMENT OF X-RAY FILMS
A Chart for Quickly Ascertaining the Proper Time of Development as Developing Solution Becomes Weakened from Continued Use
TEMPERATURE OF DEVELOPER
AT TEST
DURING USE
APPEARANCE OF IMAGE—SECONDS
20 30 40 50 60
DEVELOPING TIME—MINUTES
2 3 4 5 6 7 8 9 10 11 12
APPEARANCE OF IMAGE IN SECONDS CORRECTED TO 65° F.
20 30 40 50 60
E. SCHONS—1926

Fig. 1.

exposure holder, as suggested by Wilsey and Norris, using a 5-inch gap (87 K.V. peak), 28-inch target-film distance, ½ or 1 mm. aluminum filter, and 15 milliampere-seconds. Have a definite setting for this and always use the same technic and exposure in order that the tests may be exactly comparable. During this exposure have the middle portion of the film covered lengthwise with a piece of lead, as described by Wilsey and Norris, so that this portion of the film will not be exposed. In the dark room cut this film with its black paper cover lengthwise through the middle so as to have two strips, each having an exposed and an unexposed portion. Preserve these strips within their black papers and in a safe place, where they will get no exposure, for use in making the tests.

The test should not be made immediately after coming in from bright daylight and one should have been away from very bright light of any kind for a few minutes, in order to have sufficient acuity of vision. Read the temperature of the developer and partly fill a glass or cup and set it in front of the dark room safe-light. Turn out the white light and cut two strips about one-fourth inch wide from the end of one of the exposed strips of film, as described above. Put the remainder of the strip safely away for future use. Drop one of the small strips into the developer held closely in front of the dark room safe-light and immediately begin counting seconds by any convenient method, such as a stop watch, ordinary watch with a second hand, or, very conveniently, the ticking of an ordinary alarm clock, which ticks exactly four times per second. Note the number of seconds at which the line of demarcation between the exposed and unexposed portions first definitely appears. Repeat this procedure with the other piece of film as a check and take the average of the results. This test should be made immediately after dipping out the developer from the tank and before it has changed in temperature. Development need not be carried further than the appearance of the image, when the white light may be turned on.

Using the chart, find on the left side of the upper border the number of seconds at which the image appeared. Follow this line down to its intersection with the oblique line representing the temperature at which the test was made. This point of intersection when followed horizontally to the left side of the chart shows the approximate number of seconds at which the image would have appeared if the test had been made at 65 degrees and represents the speed of the developer at the time of the test. The intersection of this horizontal line with the second group of oblique lines shows, when followed to the bottom of the chart, the correct time of development in minutes.

For instance, at a temperature of 68 degrees it takes 30 seconds for the image to appear. Following the 30-second line down to its intersection with the 68-degree line, we find that, when the horizontal line passing approximately through this point of intersection is followed to the left, it indicates 34 seconds. This shows that the developer is much weaker than freshly prepared developer, in which the image would appear at about 25 seconds at 65 degrees. The solution is, however, still very good and will produce excellent films provided development is carried to the proper point. Following this horizontal line to the right to the second group of oblique lines, and then following the points of intersection down to the bottom of the chart we find that the time of development must be approximately as follows for the different temperatures:

70°	about	5½	minutes
69°	"	5¾	"
68°	"	6¼	"
67°	"	6½	"
66°	"	6¾	"
65°	"	7	"

For convenience, enter these figures in one column on the tally chart and develop according to this schedule until the next test is made.

Make the test frequently enough so that there will be no great change in the time of development from one test to the next. The frequency of making the test will depend on the amount of work done and will vary from once or twice every day to once a week. Continue using the developer until the time required for development becomes inconveniently long. When this point has been reached it is time to make up a fresh tank of developer. As the level of the developer in the tank goes down, fresh developer should be added in the usual way.

I have found by making an exposure with two films in one exposure holder, developing one in old developer which by test has reached a point where double the time is required for development that is required by new developer, and one in fresh developer, that there is no practical difference in the quality or brilliance of the films.

CASE REPORTS

REPORT OF A CASE OF A TRI-PED BABY

By W. H. WALLACE, M.D., Brooklyn, N. Y.

It would seem that cases of children with extra limbs are sufficiently rare to deserve to be reported.

Baby A. D., female, six and a half months old, well formed except for a mass over the left buttock from which projected a well formed foot and ankle, was admitted for treatment to the surgical service of Dr. Russel S. Fowler at the Methodist Episcopal Hospital. The baby was well nourished and healthy. The skin over the mass appeared healthy, and there was no loss of skin or any raw surface.

In the course of the study of the case the infant was sent to the X-ray department with the following questions on the consultation blank: "Is this a completely formed leg; if so, where does it articulate?" "Do the child's intestines come down into the mass and render amputation impossible?"

I think the accompanying plates (Figs. 1 and 2) answer these questions. They show that the tibia and femur are well formed and the fibula absent. The head of the femur rests against the right ilium, going clear across the buttocks. The colon was injected with a barium enema and clearly shows that it is not connected with the mass over the buttock, and so does not interfere with surgical procedure. This was reported and operation was performed.

The leg was found to be in a sac and some intestine (extraneous to the child's intestinal tract) was also found in the sac, showing that the genesis of the condition

Fig. 1. Lateral view. The extraneous intestine in the sac is not seen, since it, naturally, was not revealed by the barium enema.

Fig. 2. Anterior-posterior view showing the tibia and femur to be well formed.

was a teratoma. It is the only teratoma I have ever seen in which a well formed limb was projected from the mass. The child died.

CASE OF LUETIC OSTEO-ARTHRITIS INVOLVING FIRST AND SECOND CERVICAL VERTEBRÆ, WITH PARTIAL DESTRUCTION OF ODONTOID PROCESS

By JOSEPH ASPRAY, M.D.,
SPOKANE, WASHINGTON

M. F. T., male, aged 40, consulted a physician on March 17, 1926, for pain in the left side of his chest, and dyspnea. These symptoms had begun eleven days earlier with chills and fever; the pain was very severe on breathing, and respiration was rapid and shallow.

Physical examination at that time gave no findings of significance in head and neck, abdomen, bones and joints, or genito-urinary tract. There was dullness over the right base (lung) posteriorly, also absent breath sounds. A diagnosis of lobar pneumonia in both bases was made.

At that time a history was taken; the patient could remember no illnesses except lumbago a year before and an attack of influenza—exact date unknown.

During the month of March, the patient had two roentgen-ray examinations of the chest which revealed evidences of an extensive bronchial inflammatory reaction throughout both lungs, possible resolving pneumonia in the left base, and pleuritic thickening.

The patient left the hospital on April 9, 1926, his condition improved but not entirely cleared up. About one week before this he noticed stiffness in his neck for the first time. Gradually this stiffness grew more pronounced until it compelled him to seek medical advice again on April 20, 1926.

At that time physical examination showed a definitely stiff and painful neck. There was dullness over the base of the right lung posteriorly; râles were heard over this area. Heart rapid, but otherwise normal. Sputum examination was negative for tubercle bacilli. The clinical diagnosis made was unresolved lobar pneumonia. At this time films of the chest revealed extensive parenchymatous lesions throughout both lungs suggestive of resolving pneumonia.

Ten days later, roentgen examination showed moderate fibrosis and nodal enlargement in both lung fields, but no demonstrable abscess, pleural fluid, or acute pathological process.

On May third, because of persistent stiffness of the neck, films were taken of cervical vertebræ; they showed no demonstrable injury or pathology.

Four days later a lumbar puncture was done and the spinal fluid examined. The findings were as follows: 1 cell per cu.mm., slight trace of globulin, Wassermann four plus, colloidal gold 3332000000. At a later examination these findings were confirmed. The blood Wassermann was found negative. A small amount of fluid aspirated from the knee joint showed 16,000 cells per cu.mm., with 96 per cent polymorphonuclears and 0.4 per cent lymphocytes; no bacteria were isolated.

The patient left the hospital again on May 28, 1926, after the above diagnostic tests were made. Active anti-luetic treatment was instituted at this time.

He re-entered the hospital on July 11, 1926, with the same complaint of stiffness and pain in the neck. At this time another roentgen examination was made of the cervical vertebræ. These films showed irregularity of outline in first and second cervical vertebræ, a separation of the odontoid process from the second cervical, and an abnormal lateral alignment of the upper two cervical vertebræ, producing a partial dislocation. The deduction from this examination was that there was a probable

luetic process, with bone destruction involving the first and second cervical vertebræ (Fig. 1).

After this examination a cast was applied to the neck. So long as the neck was held in perfect position the patient's condition remained good, but several times paralysis of the vital centers resulted from slight change in the position of the vertebræ involved. Finally, in one of these attacks, death occurred.

A postmortem was obtained. The findings relevant to the vertebral lesion and cause of death were as follows: The odontoid process was detached from the second cervical vertebra, and was necrotic. Microscopic examination revealed a bone necrosis resembling that of luetic lesions.

SYPHILIS OF THE STOMACH

REPORT OF CASE

By CONLEY H. SANFORD, M.D.,
MEMPHIS, TENN.

Dr. P. B. Mulligan's excellent report of a case of syphilis of the stomach in the July, 1926, issue of RADIOLOGY prompts me to report a similar case which, so far, has responded very beautifully to medical treatment. For the sake of brevity, irrelevant and negative data are excluded from this report.

Mrs. A. P. McC., housewife, aged 23 years, was referred to my associate, Dr. W. T. Swink, Aug. 2, 1924, complaining of pain in the epigastrium of eight months'

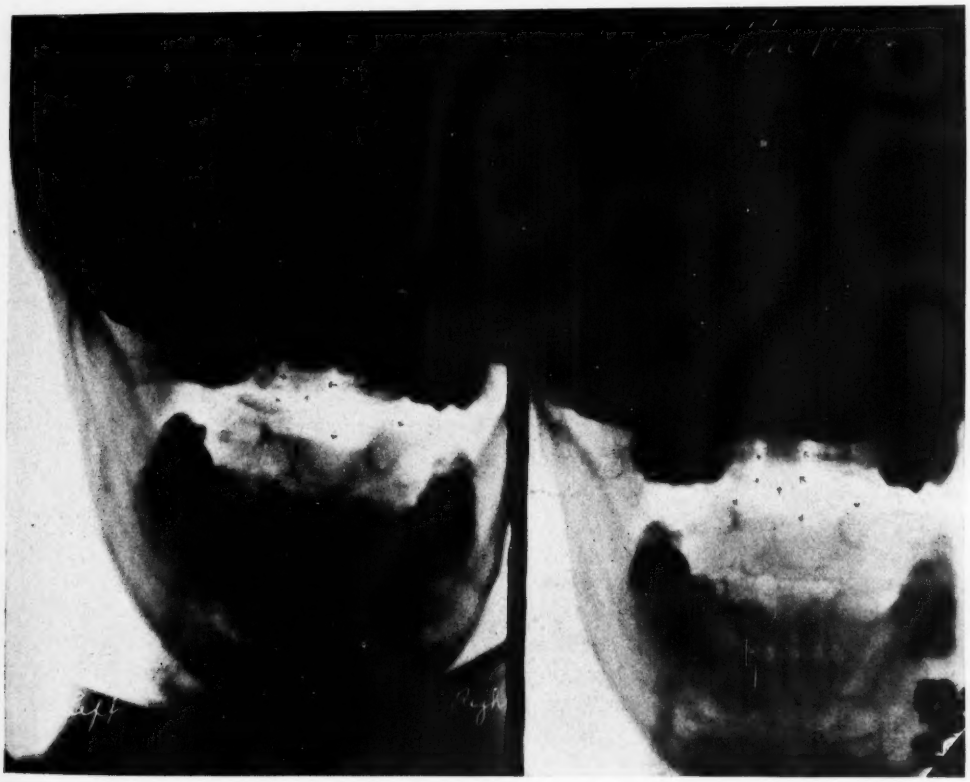


Fig. 1. Bone destruction involving the first and second cervical vertebræ, of luetic origin.

Fig. 1. Appearance of stomach before treatment was instituted.

Fig. 2. Same after one year of treatment (from Dr. Smithies).

duration, with "indigestion" for one year. Pain usually relieved by drinking milk. Four days prior to examination the patient was awakened at 5:30 A. M. with epigastric pain; she drank a glass of water and immediately vomited the water with mucus and some blood. Had vomited blood two weeks prior to this time. Vomiting of material which was not sour occurred three or four times a week, but no blood had been detected except on the two occasions just noted. Constipation was an obstinate symptom, requiring laxatives every day; no tarry stools had been observed.

Past and family histories contain nothing of importance bearing on present illness. No luetic history obtainable.

Physical examination reveals slight emaciation (loss of 21 pounds in weight during the past nine months) and moderate tenderness in the epigastrium.

Laboratory Findings.—Urine normal except three plus indican. Blood: normal cell count, 70 per cent hemoglobin. Wassermann four plus in our laboratory and checked by examination in two other laboratories. Feces negative for ova, parasites and occult blood. Fractional gastric analysis disclosed a low total acidity, with complete absence of free hydrochloric acid and occult blood in the stomach contents.

Roentgenological examination revealed the following: Habitus, hyposthenic. Stomach unusually high, considering habitus. At the junction of the pars media with the pars pylorica there was an area of constriction in the wall of the stomach, at which point the lumen was only 3 cm. in diameter, producing a partial hour-glass appearance (Fig. 1). The above abnormality persisted during the entire time the stomach was observed (about two hours). Pylorus, markedly spastic. Stomach practically free from visible peristaltic waves: empty at

six hours. No abnormalities detected elsewhere in the gastro-intestinal tract.

Clinical Course.—Patient was given peptic ulcer diet and advised to remain at rest in bed. Arsphenamine 0.4 gm. was administered intravenously at weekly intervals and potassium iodide and mercury given by mouth. After two weeks the patient felt so well that she refused to remain in bed and did not adhere strictly to diet. No symptoms were present after this time. Gain in weight was steady and rapid so that at the end of eight weeks her weight was 109 pounds, a gain of 24 pounds. In November the patient moved to Kansas City, and later to Chicago, where further observation and treatment were carried on by Dr. Frank Smithies. A letter from the latter dated July 18, 1925, stated that the stomach appeared normal at that time, as may be seen from the roentgenogram (Fig. 2) sent by him.

EDITORIAL

END-RESULTS

When the forces of Nature are set into action, one readily finds definite results. No terrestrial body or bodies can be formed or created without setting these physical forces into action. These results may be either the formation or the destruction of life, the formation or the destruction of planets. Just so, upon the creation of the human being certain forces are set into action which must bring about definite end-results. The process involved is not always any too clear and even the end-result itself may be obscure. If the action is along lines recognized as being orderly and proper, it is spoken of as being physiological, whereas if the action becomes unruly and destructive, it is called pathological. Certainly these processes are constantly taking place within the individual and are being influenced greatly by the forces of Nature without the individual.

When the result of any action within an individual becomes sufficiently disorderly he becomes the patient of some physician. The appendix is removed, the gall bladder removed, a gastric ulcer treated, or tuberculosis diagnosed and treated. The physician is then placed in the rôle of treating or the surgeon of removing an end-result. The forces within and without the patient which brought about the result have usually been long at work, slowly and silently to the patient, vaguely perhaps to the physician.

Who would say that the changes in a chronic antrum occur in a few weeks, months or years, and what about chronic appendicitis or cholecystitis. In a like manner, may one not also question the superimposed acute conditions? Hurried periodic examinations can detect certain processes which are becoming pathological and perhaps are already pathological, with the end-result in sight, but our vague knowledge of what constitutes normal physiology allows every other process to go unquestioned. Further, these examinations begin only with the adult and usually the adult past middle life. What about all the forces that have been in action for the previous forty or fifty years? Certainly some attention to the child or infant might prevent a physiological process from becoming disorderly, a process which may have started with the fertilization of the ovum and has been accentuated since birth by environmental conditions.

Is it, then, too visionary to expect the physician of the near future to have a better knowledge of the physiological processes of life and their pathological variations, to expect him to devote more time and study to these processes and less to treating end-results? The laboratory has very greatly aided the eyes and the fingers; cannot the X-ray do as much? Even the radiologist must be accused of diagnosing chiefly the end-results and only here and there has a study been made of the physiological processes. Yet the radiograph portrays the physiological as well as the pathological conditions, and at times even better. May not the radiograph of the future disclose to us many of the mysteries and play a great part in the prevention of adult disease and end-results?

W. W. Wasson, M.D.

CENTRAL ILLINOIS RADIOLOGICAL SOCIETY

The January meeting of the Central Illinois Radiological Society will be held in Springfield, for the conduct of annual business matters and the election of officers.

The program of the October meeting was furnished by Dr. Roswell T. Pettit, of Ottawa, who read a paper on "Measurement of X-ray Dosage in Deep Therapy"; Dr. Arthur Sprenger, of Peoria, on "The Relationship between the Urologist and the Radiologist"; Dr. Walter Bain, of Springfield, on "My Bad Results in Radiation Therapy," and Dr. Henry Grote, of Bloomington, on "Thymic Disturbances and Result of Treatment."

Dr. P. B. Goodwin, of St. Francis Hospital, Peoria, is Secretary of the Society.

THE CATHODE RAY TUBE—A DEVELOPMENT OF THE GENERAL ELECTRIC RESEARCH LABORATORY

A vacuum tube which produces as many electrons per second as a ton of radium—and there is only a pound of that rare substance in the world—was announced by Dr. W. D. Coolidge of the Research Laboratory of the General Electric Company at a meeting of the Franklin Institute of Philadelphia, on the occasion of the award to him of the Howard N. Potts gold medal of the Institute for his outstanding work in the development of X-ray tubes.

Radium is constantly disintegrating, and in so doing is bombarding electrons—infinitely small particles of matter or electricity—into space at very high velocities. The rate at which radium disintegrates is beyond human control; nothing that man can do seems to affect the rate at which the element breaks down. The cathode ray tube likewise bombards high speed electrons into space, but at a rate that can be controlled by man, and in quantities far greater than by all the radium in the world. The electrons given off by radium are of higher average velocity than those so far produced with the cathode ray tube, but otherwise the two are alike.

So much more concentrated are the rays from the tube that many startling experiments have been conducted with the new device. Crystals of the mineral calcite apparently become red hot coals when exposed for a moment to the rays, but they are glowing with cold light; ordinary salt is turned brown, and considerable time elapses before it again becomes the colorless substance it usually is; bacteria and small flies are almost instantly killed by exposure to the rays; ordinarily colorless acetylene gas is transformed into a yellow solid which cannot be dissolved; and a rabbit's gray hair has been destroyed, to be replaced later by a profuse growth of longer, snow-white hair.

Cathode rays have been known to some extent for many years. At first, however, they were known only within vacuum tubes, but about thirty years ago a European scientist, Lenard, succeeded in making the electrons pass through a tiny piece of extremely thin aluminum foil cemented to the glass wall of the tube. Improvements have been numerous since then, but with previous tubes the metal "windows" were much smaller and the operating voltages much lower than with the new tube.

Several unusual features have been incorporated in the new tube. There is a "window" three inches in diameter, of nickel foil the thickness of which is measured in thousandths of an inch and which is capable of withstanding a total atmospheric pressure of more than a hundred pounds. A heated tungsten filament, originally used by Dr. Coolidge in the X-ray tube and now known to all as an essential part of radio tubes, furnishes the supply of electrons. The glass tube has been shielded with a copper tube so that the stream of electrons cannot strike

the glass and cause punctures, thereby permitting operation of the tube at voltages far higher than any previously attained, and the tube is also the first which it has been possible to seal off from an evacuating system; the tube thereby has been made as portable and as easy to use as an X-ray tube.

Electrons are released by the heated tungsten filament, or cathode, at relatively low velocity—a matter of a mile or two per second. Between the cathode and the anode—the "window" and the copper tube which serves as a shield—there is impressed upwards to 350,000 volts of direct current. This causes the electrons given off by the filament to speed up to an average velocity of 150,000 miles per second or more, depending upon the voltage, within the short space of about one inch between the cathode and the copper tube shield. Having attained this high velocity, the electrons coast the rest of the way through the highly evacuated tube and pass through the anode, or window, and into the atmosphere with but slight diminution in velocity.

The nickel window is soldered to a disk of invar, an alloy which expands the same amount as does glass when heated. The invar disk, in turn, is fused to the glass tube, thereby making the seal air tight. The thin piece of nickel itself could not withstand the atmospheric pressure of one hundred pounds —the difference between the outside air and the almost perfect vacuum within the tube—so it is reinforced with a honeycomb structure of molybdenum metal, a design that affords a maximum of strength with a minimum of cross-section area.

If the tube is operated in a darkened room, a hum is heard and the window of the tube is seen to be surrounded by a ball of purplish haze, about two feet in diameter with 350,000 volts and more or less depending upon the voltage. This glow, which shows the penetration of the cathode rays in air, results from the air being ionized or broken up by the rays or electrons. The penetration of the rays depends not only upon the voltage but upon the density of the substance they strike, so that with most solid substances the penetration is slight, and with dense metals almost negligible.

One of the most startling experiments performed with the new tube has been the production of a yellow compound when the rays are passed through acetylene gas. This compound, similar to that produced in very small amounts by radium treatment of the colorless gas, can be produced in relatively large quantities with the cathode ray tube, either as a light, fluffy powder or as a varnish-like film on substances within the gas chamber, depending upon the electrical conditions. The compound has been found to be insoluble in all the many chemicals so far tried. It seems, therefore, that a use may be found for it as a protective coating for metals, to which it adheres tightly. Other substances, such as castor oil, can also be solidified by exposure to the rays.

In ascertaining the effect of the rays on living tissues, small circular areas of the ear of a gray rabbit were subjected to short exposures to the rays. Exposure of a tenth of a second caused a temporary loss of hair over that area. When the exposure on another area was increased to one second a scab was formed. When this fell away it took the hair with it, and weeks later the area became covered with a profuse growth of longer, snow-white hair. Exposure for a minute resulted in the formation of a scab on each side of the ear. A hole was left in the ear when the scabs fell away, and the edge later became fringed with white hair. In other experiments, bacteria and flies were killed almost instantly by the rays.

A crystal of calcite, a colorless and transparent mineral, glows with a bright orange light if subjected to the rays, and the glow of cold light continues for hours. The glow comes from an area very near the surface of the crystal, since the rays penetrate but little into the substance. Immediately after

the crystal has been rayed, numerous bluish-white sparks or scintillations can be noticed beneath the surface of the crystal; these are electrical explosions, the result of the bombardment of the atoms in the crystal by the high-speed electrons.

Granite, a mixture of several minerals, glows with several brilliant colors, some of the colors fading away immediately and others remaining for some time. Numerous other substances can be made to change in color, some permanently and others for a short time.

The commercial possibilities of the tube, still a laboratory development, are unknown, but it is expected that the tube will be invaluable in scientific investigations regarding electronic phenomena.

FIRST PHYSICIANS' HISTORY WRITTEN BY PHYSICIANS TO BE PUBLISHED

What is said to be the first comprehensive history of the activities of the medical profession, as distinguished from a history of medicine, from the earliest times to the present day, a work as broad in its outline of the subject as H. G. Wells' "Outline of History" and of which many chapters have been contributed by eminent physicians themselves, is about to be published through the efforts of the Physicians' Home, Inc., the headquarters of which are in the Times Building, New York City.

This announcement was made recently by Charles Capehart, who is directing the campaign of the home for a $2,000,000 endowment fund, and who outlined the scope of the work which, under the title of "A History of the Physician," is in five parts and is being edited by Arthur Selwyn-Brown, B.Sc., M.A., Ph.D., LL.D., whose previous literary efforts and wide experience in the fields of science and exploration in behalf of the British government have, it is felt, peculiarly fitted him for the ambitious task.

Dr. Brown, who has contributed historical and biographical writings to numerous encyclopedias, including Nelson's New International and Larden's, and is the author of "A History of Prices, the Psychology of Evaluation," "The History of Science" and other works, as well as a writer for many magazines and newspapers, including the *New York Times, Herald-Tribune* and *New York American,* in his preface to "A History of the Physician" asserts that the practice of medicine has recently been definitely traced by scientists as far back as the Stone Age.

"Primitive man hundreds of thousands of years ago was attended in his sickness by men who were expert in medicine," declares Dr. Brown. "Recent studies of the cave bones discovered in Europe show that fractures were well set and that many surgical operations were carried out by the surgeons of the Stone Age."

No works about physicians have up to now been written, like those of Plutarch, dealing with the lives of distinguished personages in classical times, nothing like Smiles' "Lives of the Engineers," nor books corresponding to those of Ruskin on the work of artists and architects, nor biographical studies like those of Lords Campbell and Birkenhead on the great jurists of England. "The History of the Physician" is intended to remedy the omission and to trace the history of the doctor's labors from the remotest times to the present, so as to show how the basic principles of modern medical science were established, not in one age or country, but by the co-operation of medical men in all parts of the world, patiently laboring over long periods of time.

"A History of the Physician" is to contain biographies of outstanding practitioners since classical times, as well as of prominent American physicians of the past century, and one of the most important features of the work is a series of sketches, contributed by recognized contemporary authorities in

the several lines, of the men who have aided most in bringing about the present efficient methods in special branches of medicine.

Dr. Brown acknowledges the co-operation he has received from the profession and states that every member consulted has expressed his hope that the book may prove invaluable to all interested in the physician and serve as a text book for students who are desirous of studying the history of medicine and tracing its evolution. It is believed that its subject matter will prove of intense and fascinating interest not alone to the layman, to whom it will afford a new concept of the physician's struggles, sufferings, and sacrifices in the cause of humanity, triumphs and rewards, but that the professional reader will derive from his studies of the work of physicians of yesterday, before yesterday and in the remote past, new guiding principles and a wider scope of thought in the pursuit of further medical knowledge.

It is announced by Mr. Capehart that the proceeds from subscriptions for "A History of the Physician" are to be devoted to increasing the endowment fund for the Physicians' Home and that several large subscriptions for copies of the work, the edition of which is to be limited, have already been received from wealthy persons. The nominal price placed on the book is $15, but several persons have subscribed sums as large as $500 for it.

EDITORIAL COMMENT

This laudable movement should have its counterpart in different sections of the country, where indigent, but worthy, fellow-practitioners could have access to homes of tranquillity so justly earned.

Faithful service, cheerfully given, often at great sacrifice, with little or no thought of compensation, should be rewarded, and it is to be hoped that men who found our universities, our libraries and playgrounds will set aside a small portion of their benevolence to make possible a contented sunset to those who gave of themselves to the utmost.

ABSTRACTS OF CURRENT LITERATURE

INDEX TO ABSTRACTS IN THIS ISSUE

Cholecystography.—In Stanford Medical Department they have used sodium tetraiodophenolphthalein exclusively for a period of eight months, giving it both in pill form by mouth and in solution by intravenous injection. In the oral method one 5-grain stearin-coated pill for each 10 pounds of body weight is given about 6 P. M., after a light dinner, patient instructed to take plenty of water with the pills, to lie down and take nothing more by mouth. Out-patients having a complete gastro-intestinal series taken, routinely take the pills on the evening of the first day of the examination. The first gall-bladder films are taken at the time of the twenty-four-hour gastro-intestinal film. Dr. Cheney has found cholecystography by means of the pill to be unreliable except for the visualization of the normal gall bladder.

Intravenous solution is prepared by dissolving 3 grams of the dye in 50 c.c. of distilled water and autoclaving for twenty minutes. The gravity method has been used for injecting the solution, a salvarsan cylinder with a long tubing being used. A two-way connection and intravenous needle are attached and normal saline at body temperature is allowed to run through till all the air is expelled. The solution of dye is filtered through a medium filter paper and added to about 10 c.c. of the saline solution in the cylinder. Special care is used to make sure that the needle is in the vein. About ten minutes is taken for the injection and the dye washed out of the apparatus with about 25 c.c. of saline solution at body temperature. The dye is injected at about 5 P. M. The patient goes without supper but receives fluids up until midnight. The film is made at 8 the following morning, after which a meal rich in fats is taken by the patient, another film being made at 11 o'clock.

F. B. SHELDON, M.D.

The Technic of Administration of Sodium Tetraiodophenolphthalein in Cholecystography. Garnett Cheney. Calif. and West. Med., October, 1926, p. 492.

Unusual features in Paget's disease.—This report is based on personal observation of 50 cases of Paget's disease, a few unusual observations prompting the report. Paget's produces a characteristic picture when it involves the skull. Numerous instances of "monosteitic" involvement are cited, to which the author adds three cases, one of the tibia, one of the right innominate, and one involving the sphenoid bone. A few cases in the series deserve special comment. One was the occurrence of a pronounced and generalized Paget's in a boy 16 years old, presenting a characteristic appearance. The same patient had a spontaneous fracture of the humerus. Another case was one of marked destructive bone changes on the frontal and parietal bones. Two cases showed an associated calcification of the membranes within the skull, calcified falx cerebri. The article is well illustrated by radiographs of the condition.

L. R. SANTE, M.D.

Paget's Disease. Herman B. Philips. Jour. Bone and Joint Surg., July, 1926, p. 643.

Intra-oral cancer.—The best practical means of treating cancer at the present time is by surgery and irradiation. Slightly advanced, strictly intra-oral lesions may be removed surgically. Advanced and inaccessible lesions should be treated with radon. The authors claim that in order to be successful at least 1,000 mc. should be concentrated in the lesion. They recommend two methods of treatment—surface irradiation and intra-tumoral radiation. Tumors more than 3 cm. in diameter, or near vessels or bones, to be treated by surface irradiation; smaller and well localized growths may be treated by the intra-tumoral method. Tumors of tongue and soft palate are treated by surface irradiation. Cross-fire radiation should be utilized when possible. In surface radiation, the applicator should fit the lesion, and the application be not less than 1,000 mc. This is screened with 2 mm. of silver and applied for 15 minutes.

In intra-tumoral radiation, small glass tubes containing from 0.5 to 1 mc. of radon are buried 1 cm. apart evenly throughout the growth by means of an obturator and sterile needle.

Distance irradiation for cervical lymph nodes is carried out about as follows: blocks of

soft wood 4 × 4 × 4 cm. are used as radon applicators. The blocks are strapped to the skin and a flat metal box holding from 20 to 50 tubes, containing from at least 500 to 1,000 mc. of radon, is strapped to the blocks. At this 4 cm. distance 7,000 mc. hours may be given.

General results, assuming that 17 untraced patients are dead, are as follows: total mortality 63.3 per cent; 20 (35.7 per cent), out of the total of 56 cases reported, have been well for periods of from 3 to 5 years.

The authors conclude as follows: "For the best results in intra-oral cancer, at least 1,000 mc. of radon must be available, while experience in its use would appear to be necessary."

C. H. DeWitt, M.D.

Radon (Radium Emanation) in the Treatment of Intra-oral Cancer. Frank E. Simpson and Roy E. Flesher. Ill. Med. Jour., October, 1926, p. 305.

Measures for reduction of congenital dislocation of hip.—The report is based on 310 cases of congenital dislocation of the hip—the most recent of the series being of five years' duration. Of 266 cases traced to a conclusion, 103 cases, or 39 per cent, remained in the acetabulum—40 cases maintained a sufficiently satisfactory position to give a good functional result.

The importance of the age of the patient is brought out very clearly in the study. It was found that the earlier the dislocation was discovered and reduced, the greater the percentage which remained permanently in place. The routine examination of all newborn babies for this deformity is recommended. The Hibbs table, manipulation without table, and open reduction were methods employed. In 23 instances reduction could not be effected by any means. In only seven cases did the X-ray indicate a perfect anatomical result. The functional result usually was better than the X-ray would indicate.

The authors' conclusions are as follows:

"1. In any large series of cases of congenital dislocation of the hip as now seen, success by closed reduction can be expected in only about 50 per cent.

"2. These results could be improved upon if more of the cases were treated early, and every effort should be made to bring this about.

"3. The other factors chiefly responsible for the failures are such that we cannot hope to overcome them by any method of closed reduction.

"4. In many cases the presence of these factors can be suspected but can be determined definitely only by open operation.

"5. The number of open reductions in this series is too small to justify any general conclusions. We are not yet prepared to announce the results in a larger subsequent series, but we are quite certain that many of these cases, although reduced and stable, have a considerable degree of limitation of motion which has been present for a number of months.

"6. We believe that practically every congenital dislocation of the hip within a reasonable age limit can be reduced by open operation and in that way improved.

"The results in this series of cases compel us to believe that a much larger percentage should be reduced by open operation than were so treated."

L. R. Sante, M.D.

Congenital Dislocation of the Hip. Benjamin P. Farrell, Herman L. Von Lackum, and Alan De F. Smith. Jour. Bone and Joint Surg., July, 1926, p. 551.

Influence of bowel irritation.—It has long been recognized that irritations and inflammations of the bowels, especially the large bowel, refer their pain and other symptoms to various places in the upper part of the tract. There are few, if any, instances of symptoms being referred to a lower part of the tract. There has been, and still is, a strong tendency to diagnose as gastric diseases symptoms that are only reflex evidence of bowel irritation.

This tendency of the bowel reflex to tighten the plyorus entails many evils. Emptying time suffers. The presence of barium in the stomach after four or five hours, in the absence of obvious ulcer, gall-bladder disease, or other local pathology, is in itself highly sug-

gestive of bowel irritation. Retention does not give the stomach proper time for rest. There is thus, not only (1) a delayed emptying time; (2) the loss of the rest period; (3) the prevention of duodenal regurgitation, but we have also (4) a secretion retention. The peptic glands secret hydrochloric acid in a given amount and rather constantly, but it piles up in amount if the outlet of the stomach is not functioning as it should. For years it has been taught that there is a "classical syndrome" for ulcer. With pylorospasm and secretion retention present, it is easy to understand how there can be such irritations when the stomach is empty, and also that pain will be present that can be relieved with alkalies. These patients find great relief by management that quiets bowel irritation. Bowel irritation can upset the entire tract. I believe that its effect is felt mainly in the ulcer-bearing region, and that we have every reason to look upon it with grave suspicion as a prolific cause of peptic ulcer.

F. B. SHELDON, M.D.

Some Observations on the Influence of Bowel Irritation over the Gastric and Duodenal Region. R. M. Clarke. Calif. and West. Med., October, 1926, p. 480.

Legg-Perthes' disease.—A boy 8 years of age, born in the United States, applied for treatment in June, 1925. The first time his mother had bathed him she had noticed that his left leg seemed weaker than the right. He was late in walking and the weakness of the left leg persisted; a definite limp developed and after a time there was some pain. Two years before examination the child burned the front of the left thigh without being conscious of it, the burn taking six months to heal. The result of a careful study was as follows: Blood, including Wassermann, was negative; urine negative; general physical examination negative with exception of lumbar spine and left thigh. X-ray examination showed spina bifida occulta of fifth lumbar and the sensory disturbances were thought to be due to "radiculitis" of first, second, third and fourth lumbar nerves, possibly having something to do with spina bifida. Physical examination of hip and leg showed the left side to be smaller and shorter than the right. X-ray examination revealed a flattening of the head of the femur and an irregularity of the neck similar to that seen in Legg-Perthes' disease. Open operation was performed and pieces excised for microscopic examination. At operation the head of the bone was found to be composed of cartilage apparently still well intact but in which ossification had not taken place—areas of destruction and bone replacement were noted. No sign of inflammation was found.

From an examination of the microscopic sections Dr. Phemister concludes: "The changes in the epiphysis in this case are both degenerative and reparative, the degeneration affecting the deeper portions of the cartilage and apparently most of the bone. Absorption has taken place in both the damaged cartilage and bone and there is marked degeneration and replacement, particularly of bone, without existing evidence of inflammation. The findings favor the view that the condition is the result of circulatory disturbance and they speak against inflammation. Of course, the process is of long standing and the inflammatory signs may have long since disappeared. My opinion is that, despite the early age of onset, the condition should be regarded as Legg-Perthes' disease."

L. R. SANTE, M.D.

An Unusual Case of Legg-Perthes' Disease. Frederick C. Kidner. Jour. Bone and Joint Surg., July, 1926, p. 565.

Effect of roentgen rays on nervous system.—In order to study the local effect of roentgen rays on the central nervous system, the author used the vital staining method. White mice were hypodermically injected with 1.5 c.c. of 1 per cent trypan blue solution, every five to seven days, receiving a total of 2½ to 3½ c.c.; part of the dye was injected before, the rest after, the exposure. A thorough study of the untreated but injected animals furnished the necessary data for comparison. Unfiltered radiation (quality Bauer 9) at 23 cm. distance was used; a dose of 3 Sab. corresponded to 12 to 18 minutes' exposure. The rays reached the head only; the

rest of the body was carefully protected by lead rubber. On the sixth day after treatment, a severe conjunctivitis appeared; after two weeks, epilation and sometimes erosion occurred; a few mice died; the majority were killed with ether between the fourth and sixth day. Brain, spinal cord and inner organs were taken out, fixed in 10 per cent formol solution, and the frozen sections stained with cochineal or alum-carmin. As principal change after irradiation, an increase of vital stained histocytes and the appearance of blue stained drops in the endothelium of the blood vessels could be noticed. The spinal cord presented the same changes but to a lesser degree. By irradiating the body and covering the brain carefully, these described changes could not be reproduced. It is evident, therefore, that the observed effect is due to the direct exposure of the nervous system.

E. A. POHLE, M.D.

Effect of Roentgen Rays on the Central Nervous System. A. Rachmanow. Strahlentherapie, 1926, XXIII, 318.

Mediastinal tumors. — Seventy cases of mediastinal tumors observed during the last thirteen years in the "Samariterhaus, Heidelberg," are discussed in this paper. In thirty-five patients the diagnosis was microscopically verified. Twenty patients lived longer than two years; of these, there were six cases of Hodgkin's, two of malignant struma, one of hyperplastic thymus, five of malignant tumors (clinically diagnosed only). Sixteen patients lived longer than three years; of these, there were five cases of Hodgkin's, two of sarcoma, one of carcinoma (histologically diagnosed); two of malignant struma, one of hyperplastic thymus, five of malignant tumors (clinically diagnosed only). Seven patients lived longer than five years; of these, there was one case of Hodgkin's, one of sarcoma, one of carcinoma (histologically diagnosed), four of malignant tumors (clinically diagnosed only). Twenty patients are still under treatment, five of whom are working. Roentgen examination of the chest is negative. One of the five patients at present working is a case of metastatic sarcoma (primary tumor in the testicle) that has been four years under observation. The other four cases (malignant tumors without specific diagnosis) have been under observation for one, two, and six years, respectively. Nine patients are able to work but still present positive roentgen-ray findings; the remaining six patients are unable to work and have clinical symptoms of the disease.

In conclusion, the fact is emphasized that not in a single case of mediastinal tumor is it possible to give a definite prognosis. Therefore, all patients except those with pronounced cachexia should be treated by radiation. At least 50 per cent of the erythema dose seems to be required for response; no definite dosage can be given, since each case has to be considered individually.

E. A. POHLE, M.D.

Regarding the Roentgen-ray Treatment of Mediastinal Tumors. J. Schaaff. Strahlentherapie, 1926, XXIII, 297.

Light biology.—This is an excellent critical review of the biological problems in light therapy, and is heartily recommended for study in the original text.

E. A. POHLE, M.D.

Old and New Experimental Investigations Regarding the Effect of Light. H. Meyer. Strahlentherapie, 1926, XXIII, 369.

Bone lesions.—This is the second of a series of papers dealing with the subject of periosteal lesions.

Latent and healed bone lesions.—Cases are reported as revealed by X-ray taken for some other cause, a case of an unsuspected chondroma in the lower end of the femur being cited. A certain group give a history of trauma but no evidence of fracture, while an X-ray plate taken at the time fails to disclose any evidence of fracture but shows other pathology. An example is cited of a man who sprained his knee. X-ray examination revealed a tumor in the bone of the epiphysis of the femur, at first thought to be a giant cell

tumor but revealed by operation to be a large bone cyst. Bone cysts are rare in the epiphysis and usually occur before 18 years of age. Another instance is cited of a girl who sprained her ankle. X-ray examination revealed a central lesion of the shaft of the tibia undergoing ossification—the most common lesions to undergo spontaneous ossification are bone cysts. Up to the present time, in an individual with no previous symptoms, an X-ray plate taken because of recent injury has never revealed a giant cell tumor, a sarcoma, or a metastatic tumor. When the injury has been associated with a fracture, cysts and metastatic tumors have been found.

Pathologic fractures.—One hundred thirty cases of pathologic fracture have been noted in 1,000 bone tumors. Where these fractures have occurred without previous pain, swelling, or loss of function in the bone involved, the lesions responsible have been bone cysts or metastatic tumors. Although the appearance may be the same, metastatic tumors are more common on adults, and bone cysts under 18 years of age. There are exceptions to both. An instance is cited in which a woman 50 years of age fell and fractured both bones of a leg. X-ray examination revealed a pathologic fracture through a central tumor of the tibia—showing expansion and thinning of the cortex. Exploratory incision revealed a bone cyst. Pathologic fracture occurs in all types of bone lesions—these occurrences then cannot be considered as diagnostic of the lesion. If not preceded by pain or swelling they are probably due to bone cyst or metastatic tumor —no instance can be found where a pathologic fracture was the first indication of sarcoma or giant cell tumor.

Relation of bone lesions to trauma.—When we go over the evidence—which is getting larger and more accurate every year—we can feel gratified that the previous conceptions of the relation of trauma to lesions of bone are being confirmed.

Bone cysts.—All evidence is against trauma as a cause of bone cyst. In fully 40 per cent of all patients coming under observation because of fracture, the cyst is already present on the X-ray plate. Osteitis fibrosa, the underlying pathology of bone cysts, is undoubtedly an inflammatory process. It tends, like all other inflammatory processes, to spontaneous healing, but its cause has not yet been found.

Giant cell tumor.—Here evidence suggests strongly that trauma may be a factor. An instance is cited where, after injury to the knee, a giant cell tumor developed in the condyle of the femur. X-ray examination showed a normal bone after injury and a slow progressive development for nine weeks—proved by operation. Codman and others are of the opinion that giant cell tumors are due to hemorrhage into the bone in the cancellous tissue of the epiphysis. This leads to disorganization and complete destruction of the bone and a granulation tissue forms, filled with foreign-body giant cells.

Chondroma—myxoma.—There is no evidence that trauma has any relation to these growths. Chondromas are evidently congenital residues; myxomas are degenerative processes in chondromas. When they occur in the epiphysis of adults they are difficult to diagnose from giant cell tumor, but when one observes a central tumor of the shaft in an adult, one should always bear in mind chondroma, myxoma, metastatic tumor and myeloma.

Sarcoma.—The majority involve the entire bone; most are periosteal in origin. A certain type of central sarcoma does, however, occur; the majority of these are myxosarcomas or chondrosarcomas. Undoubtedly there are two types of periosteal sarcoma; one associated with ossification, the other merely fibrosarcoma unassociated with ossification, which may perforate into the haversian system and produce marrow tumors without any changes in the cortical bone to be seen in the X-ray examination.

Diffuse sarcoma.—Two distinct types are revealed by the X-ray: the sclerosing type, which may be associated with excessive periosteal bone formation, and the osteoporotic type, which rapidly becomes destructive. The sclerosing type is well known and most frequent; the osteoporotic type is rare and resembles atrophy from disuse but occurs without disuse and in the shaft. Nothing else gives

this appearance to the X-ray except, rarely, multiple myeloma.

Trauma and sarcoma.—Evidence suggests relation of trauma to sarcoma.

Sarcoma and fracture.—There is one verified example of sarcoma that succeeded a fracture—very rare. The trauma that produces a fracture rarely is followed by malignancy.

Chronic irritation and cancer.—It is now accepted that chronic irritation is one of the causes of cancer and that a single or repeated trauma is one of the causes of sarcoma, but there are other undiscovered causes also.

Central single lesions of the shaft in children under 18.—This practically means a bone cyst; there are very few central giant cell tumors at this age; multiple myeloma (coming under observation as a single lesion) may occur rarely. If there is a fracture through the cyst, treat it as a fracture; if union does not occur in six weeks, explore, because of possibility of giant cell tumor. Giant cell tumor requires thermal and chemical cauterization after curetting. If no fracture has occurred, watch with repeated X-ray examinations. If deformity results and ossification is slow, operate. Bone cysts have the following gross appearances: (1) Bone shell and fluid; (2) bone shell, connective tissue lining and fluid; (3) bone shell, mass of fibrous connective tissue without minute cysts or with minute cysts (polycystic). In the thick connective tissue lining or in the solid mass there may be red areas which under the microscope resemble giant cell tumor. The connective tissue lining may be covered with a white snow of calcium deposit. The fluid may be clear or cloudy. The bone cyst needs neither chemical nor thermal cauterization. It insures more rapid ossification if the connective tissue within the bone shell is removed and the shell is fractured or crushed. Giant cell tumor has entirely different gross appearance. The cavity of the bone is filled with a hemorrhagic, cheesy material, which bleeds like edematous granulation tissue, and the bone shell bleeds when it is curetted. There may be a cavity filled with blood, with this friable, red granulation tissue lining the bone shell. This tumor needs thermal and chemical cauterization after curetting. In central lesions of the shaft in children the chances of giant cell tumor are so small that it is not advisable to give X-ray or radium treatment. Cases so treated have not shown any greater or more rapid ossification.

Central lesions of the shaft in adults.—The majority of these are chondromas, myxomas, metastatic tumors, myelomas and possible chondrosarcomas; rarely latent bone cysts. The author has never seen a giant cell tumor in the shaft of an adult bone. One is justified in using radiation therapy first in central lesions of the shaft of the bone in adults; if there is no response under treatment, operate.

L. R. SANTE, M.D.

How to Diagnose and Treat a Bone Lesion: I—Central Lesions. Joseph Colt Bloodgood. Jour. Bone and Joint Surg., July, 1926, p. 471.

Roentgen therapy of hemorrhage of the retina.—The successful treatment of hemorrhagic glaucoma induced the author to try it out in cases of hemorrhage in the retina, of tuberculous, arteriosclerotic, luetic, and traumatic origin. A filter of 4 millimeters of aluminum or ½ millimeter copper was used; a total of 2 to 2½ full doses were given, according to the fractional dose method, at intervals of eight days (no other data published). In five cases prompt resorption of the hemorrhagic infiltration occurred.

E. A. POHLE, M.D.

Treatment of Hemorrhagia in the Retina with Roentgen Rays. R. Hessberg. Strahlentherapie, 1926, XXIII, 313.

Nerve supply to bones.—The influence of the nervous system upon the nutrition of the tissues of the body is well recognized. Whatever the cause, it is true that abundant clinical evidence is found to show that certain nutritional changes occur which are termed trophic. Little precise knowledge is available about the nerve supply to bone. It is reasonable to suppose that bone cells, like other body tissues, also have nerve supply or influences which have a definite relation to the nutrition of the cell.

Four cases are described in detail, presenting definite and distinct bone changes in asso-

ciation with lesions of the lower nervous tract —inasmuch as the bone changes could be accounted for only through a disturbance in the nerve influence, it has been termed "trophic osteopathy." This condition has not been heretofore described, to the writer's knowledge. X-ray examination revealed a decrease in size of the metatarsal bones, with a tendency to spindle-shaped appearance and complete disintegration of the distal end of the fifth metatarsal.

Mumford says: "In a consideration of these cases as a whole several things are to be noted. All represent an involvement of those nerve elements which make up the superficial peroneal nerve. Not only is the etiological factor different in each case, but the level of the lesion is also different. The first case followed an anterior poliomyelitis and therefore was a cord lesion involving the nerve cells. The second case resulted from a dislocation between the twelfth dorsal and first lumbar with pressure upon the cord, which may have affected the nerve cells or the roots. The third case followed a bullet wound through the thigh, which injured the trunk of the sciatic nerve. In the last case, which was caused by a deep cut, the branch of the nerve alone was involved, the paralysis of the foot being due to the cutting of the tendons rather than to the loss of nerve supply to the muscles."

Every case of paralysis of the superficial peroneal nerve in which a callosity develops beneath the fifth metatarsal should be carefully studied for any bone change, a change which can be termed "trophic osteopathy."

L. R. SANTE, M.D.

Trophic Osteopathy. E. B. Mumford. Jour. Bone and Joint Surg., July, 1926, p. 601.

Osteomata.—Osteomata assume "a cauliflower shape and are characterized by a large amount of new bone laid down in a symmetrical manner with a very definite border and no evidence of invasion."

Three cases are reported in detail in which such growths at the lower end of the tibia encroached upon the fibula, causing thinning of that bone. One case is illustrated by roentgenogram showing a very unusual type of involvement with thinning of fibula before operation—and re-establishment of normal thickness of shaft after operation.

L. R. SANTE, M.D.

Osteomata of Lower End of Tibia. Edwin Weinberg. Jour. Bone and Joint Surg., July, 1926, p. 562.

Accessory tarsal bone.—Supernumerary bones about the foot are very common. Amongst those best known and occurring with the greatest frequency are:

1. Os trigonum, which is placed close to the posterior superior border of the astragalus.
2. Os peroneum, which is located just posterior to the base of the fifth metatarsal bone and underneath the cuboid.
3. Os vesalianum, which is in close contact with the inferior lateral border of the base of the fifth metatarsal and follows closely the outline of the main bone.
4. Accessory scaphoid, which is also known as os tibiale or os tibiale externum, though the latter two terms are undesirable. It would seem best to differentiate these two conditions.

Attention is called to the ease with which an accessory scaphoid may be mistaken for a fracture of the tubercle of the scaphoid. Several cases were operated on and the accessory bones were removed. It was found that the tibialis posticus completely covered the accessory bone.

The author's conclusions are as follows:

"1. Supernumerary bones about the ankle are of frequent occurrence.

"2. Their existence is of considerable medico-legal importance, as they have been mistaken for fractures.

"3. The particular importance attaching to the presence of the accessory tarsal scaphoid lies, not in the presence of this accessory bone *per se*, but in the fact that it indicates an abnormal insertion of the tibialis posticus tendon, which produces a 'weak foot'—the tendon

being entirely or mainly inserted into the scaphoid.

"4. No special sensitiveness on pressure is associated with the accessory tarsal scaphoid.

"5. Some of these patients come for examination because of the prominence in the position of the scaphoid without additional symptoms.

"6. This condition probably accounts for many of the failures in treating weak feet according to conventional methods.

"7. Removal of the accessory scaphoid bone and the prominent portion of the scaphoid is indicated in many cases.

"8. Astragaloscaphoid arthrodesis is deserving of another trial with better technic."

The author states his indebtedness to Dr. P. W. Roberts, Chief of the Second Division at the Hospital for Ruptured and Crippled, for his interest and the privilege of operating on these patients.

L. R. SANTE, M.D.

The Significance of the Accessory Tarsal Scaphoid. Isadore Zadek. Jour. Bone and Joint Surg., July, 1926, p. 618.

Roentgen sterilization and pregnancy.—The author relates the history of a 28-year-old woman suffering from Parkinson's disease. She married in 1921; before her marriage there were two miscarriages; after marriage, two interruptions of pregnancy upon advice of a neurologist were carried out; one pregnancy came to term and a normal child was delivered in December, 1922.

There followed two more interruptions of pregnancy, the last on May 4, 1925. The patient then consented to roentgen sterilization, done in one sitting on May 13, 1925. About 37 to 40 per cent S.U.D., with deep therapy radiation, was given to the ovaries. Marital relations were taken up again on June 1, 1925. The patient had one menstrual period, on June 4, followed by amenorrhea, and she noticed soon that she was pregnant again. A normal child was born on March 26, 1926, weight 3,750 grams; no breast feeding was done; the woman has not menstruated since. It is concluded that an irradiated follicle burst and conception took place. No injury to the child has so far been detected. Reviewing the literature on the subject, it seems that irradiation of the male generative cells is much more dangerous to the offspring than exposure of the ovaries.

E. A. POHLE, M.D.

Normal Development of Embryo after Roentgen-ray Sterilization. M. Bolaffio. Strahlentherapie, 1926, XXIII, 288.

Biological effect of hard roentgen rays.—After discussing the theory of the direct and indirect effect of radiation upon tumor cells, the authors report their own experiments, undertaken in order to explain certain discrepancies between the observations made *in vivo* and *in vitro*. The radiation used was 190 K.V., 8 ma., 4.0 Al., 26 cm. F.S.D., the minimum wave length equal to 0.085 Ångström, H.E.D. equal to 500 *R*.

The following conclusions were reached: Human epithelium and the skin of adult mice are considerably less sensitive to roentgen radiation *in vitro* than *in vivo*. This is proved in observations of transplants of such tissue. Under certain conditions the transplant of the skin of the mouse exerts a poisonous effect after irradiation *in vitro*. As a working hypothesis, it is suggested that chemical changes of intercellular substances be regarded as essential for the roentgen-ray effect; the direct change of the cell of secondary importance.

E. A. POHLE, M.D.

A Contribution to the Mechanism of Effect of Hard Roentgen Rays. J. Rahm and W. Koose. Strahlentherapie, 1926, XXIII, 195.

Electrical characteristics and roentgen-ray output.—In this well illustrated paper, the authors present valuable data on the relation between the electrical characteristics of the apparatus and the energy output of the X-ray tube. A transformer with mechanical disk rectifier was used in all investigations (Radiotransformer, Koch & Sterzel, Dresden). The primary potential and current curves and secondary current curve were taken with the oscillograph, and the secondary potential

with the Seemann spectograph. At the same time the Siemens dosimeter and the ionometer (Wulf) measured the radiation. The usefulness of the automatic potential regulator (system Thoma) was also studied with the help of a recording voltmeter in the primary line and the dose recorder attached to the Siemens dosimeter. It appeared that the ohms resistance in the primary circuit led to a wrong reading of the kilovoltmeter in the switchboard; the output of the tube was decreased also. A resistance of two ohms reduced the dose 10 per cent, even if the kilovoltmeter and milliameter did not show any fluctuation. It is advisable, therefore, to use the rheostat in the primary line but very little to regulate the potential; 0.1 ohm is sufficient for this purpose. The automatic stabilizer mentioned before gave very good results.

E. A. POHLE, M.D.

Investigations Regarding Roentgen-ray Production and Electrical Characteristics of a High Tension Rectifier under Various Working Conditions. Heyde and E. Saupe. Strahlentherapie, 1926, XXIII, 217.

Osteitis.—This condition is a slowly progressive type of osteitis of the semilunar bone, causing pain and disability. This disease is a definite clinical entity which does not seem to be well recognized. The pain is aching in character, and annoying, and may result in the inability of the patient to undertake any employment which necessitates use of the wrist. In well established cases the X-ray findings are characteristic, showing osteitis of the semilunar, with fragmentation and compression of the bone. The cause is not definitely known but there is usually history of injury—not great injury but constantly applied trauma or irritation extending over a long period of time. Following a single definite injury to the bone, the pain may subside and the chronic osteitis here described set in months later. The theory advanced by Kienböch of the etiology is the one most generally accepted —that of partial or complete subluxation of the semilunar bone, with spontaneous reduction. The injury results in severance of or interference with the blood supply to the bone and the osteitis results. Two cases are reported in detail.

L. R. SANTE, M.D.

Chronic Osteitis of the Semilunar Bone (Kienbock's Disease). Melvin S. Henderson. Jour. Bone and Joint Surg., July, 1926, p. 504.

The roentgen erythema. — This is another contribution of the author to the problem of skin erythema and dosage. He comes to the conclusion that it does not suffice to observe the maximum of the reaction in the third or sixth week, but to record it during the whole time between treatment and disappearance. Individual variations in the intensity of reddening, and tanning seem to be so considerable that it is almost impossible to establish a definite relation between the biological and physical dose. Small dose variations (20 per cent) do not appear to cause measurable difference in the intensity and nature of the skin reaction.

E. A. POHLE, M.D.

Regarding the Question of Skin Erythema. L. Schall. Strahlentherapie, 1926, XXIII, 354.

Systemic effect of roentgen rays.—Some of the theories offered in explanation of the intoxication after roentgen radiation are discussed. As it seems very probable that certain products formed in the body during exposure are the cause, the author radiated one of two rats, united by parabiosis (method of Heyde-Sauerbruch). Technic: 38 to 40 cm. spark gap, 2 ma., 23 F.S.D., 4 months, no filter. This dose is fatal to rats in three or four days. Both animals showed the same leukocytosis followed by leukopenia and subnormal temperature before their death. Control experiments showed that static charge or gases in the treatment room had no influence on the rats. It seems evident, therefore, that some substance formed during the irradiation causes the fatal intoxication. The question is left

open whether proteins are the only source of these poisonous compounds.

E. A. POHLE, M.D.

Contribution to the Systemic Effect of Roentgen Rays. H. Zacherl. Strahlentherapie, 1926, XXIII, 272.

Mikulicz's disease.—This paper, by the Medical Superintendent and General Director of the London Radium Institute, begins with a brief résumé of the pathology, followed by an abstract of Mikulicz's case, after which the author reports two new cases. This disease of the lacrymal and salivary glands is a rare one, and no specific line of treatment has ever been indicated. Arsenic and iodides have been the drugs chiefly employed, and in some instances X-rays have been found to be of service.

Mikulicz's case came under observation in January, 1888, and the condition was cured by operation. The patient died in August of the same year, however, of perityphlitis.

Pinch's cases both received radium therapy, the technic and end-results being as follows: "The [first] patient received a series of five sittings, each of five hours' duration, on five successive evenings, with applicators containing 120 mg. of radium element, screened with 2 mm. of lead, applied over and around the enlarged glands, so as thoroughly to irradiate them." Two months later "the swellings in the left lacrymal, left submaxillary, and right parotid glands had completely disappeared. The left orbital fissure was as widely open as the right, and there was no longer any diplopia." A few months later the patient was found to have a greatly enlarged spleen, and "the case is regarded as one of splenomegaly of the Banti type, associated with and probably irritated by a syphilitic infection."

The second case, in which there was no history of syphilis, had both parotids enlarged, and both submaxillary glands—easily palpable through the floor of the mouth—were enlarged. The mucosa of both upper eyelids was much congested. The author gives his dosage as follows: "Treatment was carried out by means of numerous half-strength applicators, containing in all 240 mg. of radium element. These were screened by 2 mm. of lead, and so disposed as to procure an effective cross-fire radiation. The total exposure was of thirty hours' duration, given at spaced intervals over a period of three days. Two and a half months later no trace of the swellings remained." The patient is quoted as saying that "the swellings began to diminish rapidly a few days after treatment, and had quite disappeared within three weeks."

The author's comment on his cases is summarized thus: "The extremely rapid response to the treatment is undoubtedly due to the pathological nature of the malady, namely, an intense lymphocytic infiltration of the sustentacular tissue of the glands, the lymphocyte being of all cells the most susceptible to radium irradiation."

Two Cases of Mikulicz's Disease Treated with Radium. A. E. Hayward Pinch. Brit. Med. Jour., October 2, 1926, p. 586.

Lymphoblastoma.—This term includes pseudoleukemia, malignant lymphoma, lymphosarcoma and Hodgkin's disease. Almost no organ is exempt, although the early manifestations usually involve the glands; in some instances, involvement of the conjunctiva and gastro-intestinal tract occurs. There is a review of previously reported cases affecting unusual organs such as the pancreas, perforation of the jejunum and actual infiltration of the gastro-intestinal tract. In the involvement of the urinary system, the symptoms simulate renal colic, with a hematuria. Bone involvement occurred, chiefly in the sternum, with symptoms suggesting an aneurysm.

The main object of the paper is to present some of the unusual manifestations of the disease, with difficulties in diagnosis. One case report shows involvement of the dura, with abdominal symptoms, jaundice and enlarged cervical glands. Local improvement under roentgen-ray treatment was temporary, but, at operation, a lymphoid tumor was removed from the dura, followed by improvement. Another case involved the jejunum, with symptoms referable to a gastric or duodenal ulcer. The X-ray examination was inconclusive, al-

though later study of the films showed a mottling of the jejunum at first thought to be food or gas, but which is considered characteristic of lymphoblastoma of the small intestine. The third case is one of involvement of the conjunctiva, a general examination showing no involvement of other organs than the eye. Radium treatment cleared the tumor mass and relieved the pain. There is discussion of the paper, with reports of other cases and symptoms, together with the treatment.

TRESSA R. MORAN, M.D.

Unusual Manifestations of Lymphoblastomas. G. W. Holmes. Am. Jour. Roentgenol. and Rad. Ther., August, 1926, p. 107.

Use of radium in fibroids.—The cases for radium treatment must be carefully selected. The age of the patient must be considered, as well as the size of the tumor. The principal indication is hemorrhage. The subserous type of tumor is seldom affected by radium, while the submucous growths are liable to infection from manipulation during the radium treatment. As a temporary measure in bad surgical risks, radium may be used. One of the most important considerations in the use of radium is that the adnexa must be free from pathology, since latent infections may become acute in the tubes, ovaries or peritoneum. Severe anemias contra-indicate the use of radium. Preliminary curettage should be done to establish the pathology and remove polypi. Careful screening is necessary and the radium should be placed as near the fundus as possible. Shrinkage of the tumors takes place in three or four months but may be delayed to ten or twelve months, although the hemorrhage is checked within a few weeks. This opinion is given as a result of fourteen years' experience covering five hundred cases.

TRESSA R. MORAN, M.D.

Radium in the Treatment of Fibroma of the Uterus. C. Jeff Miller. Am. Jour. Roentgenol. and Rad. Ther., September, 1926, p. 228.
